Q.C
A

SIEMENS

SWEEP ATTACHMENT WITH SWEEP OSCILLATORS I AND II

A200
A198/199

10 KC/S TO 15 MC/S · Type Rel 3 W 933 b 1a / 3 W 937 b 1a / 3 W 938 b 1a

DEPT. 105

Full Information

Rel gesamt 3 W 933 b 1a En · Issue Mai 1966

SIEMENS & HALSKE AKTIENGESELLSCHAFT
WERNERWERK FÜR WEITVERKEHRS- UND KABELTECHNIK · MÜNCHEN

C O N T E N T S

Description

I. Application 1.1
II. Electrical Data 1.2
III. Functioning and Layout 1.5
IV. Designations, Dimensions, and Weights 1.21

Instructions for Use

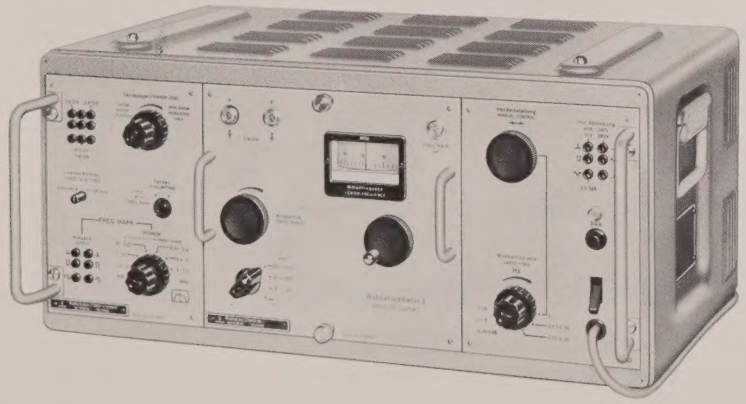
I. Preparation 2.1
II. Calibrating and Setting 2.3

Parts List

Sweep Attachment Rel 3 W 933b1a 3.1
Power Supply Unit I Rel 35 W 546b1a 3.3
Power Supply Unit II Rel 35 W 544b1a 3.7
Control Generator Rel 35 W 545b1a 3.11
Low-pass/High-pass Filter Rel 35 W 547b1a 3.14
Frequency Marker and Regulating Amplifier Rel 35 W 548b1a 3.17
Sweep Oscillator I Rel 3 W 937b1a 3.22
Sweep Oscillator II Rel 3 W 938b1a 3.31

I. APPLICATION

The Type Rel 3 W 518 carrier level oscillator can be converted into a sweep oscillator by supplementing it with the Type Rel 3 W 933 sweep attachment. This oscillator provides a voltage swept in frequency; the mid-frequency is continuously adjustable and the sweep range can be regulated so that rapid measurements in the carrier range of 10 kc/s to 15 mc/s are possible. Its high frequency stability also permits the sweeping of very narrow bands. The high measuring accuracy the setup provides is a result of the automatic regulation of the transmitting voltage to a constant value independent of frequency, and of the high accuracy of the signals generated for marking frequencies in the receiver.



Sweep attachment

Sweep oscillator I (at left)
Sweep oscillator II (at right)

II. ELECTRICAL DATA

Level oscillator Type Rel 3 W 518 . . . . . see Rel gesamt 3 W 518 En

Sweep attachment Type Rel 3 W 933 along with the level oscillator Type Rel 3 W 518

Frequency

Manual control (sweep attachment off)

Main control f_1, adjusted
in spectrum steps of 100 kc/s . . . . . 0 to 17 mc/s
or continuously . . . . . 0 to 17 mc/s

Fine control f_2, adjusted continuously . . . . . -10 to +100 kc/s
minimum readable frequency increment . . . . . about 200 c/s

Automatic sweep (sweep attachment on)

Mid-frequency, continuously adjustable from . . . . . 10 kc/s to 15 mc/s

Sweep range, continuously adjustable
with the sweep oscillator I slide-in chassis Type Rel 3 W 937, from . . . . . $\pm$10 kc/s to $\pm$7.5 mc/s
with the sweep oscillator II slide-in chassis Type Rel 3 W 938, from . . . . . $\pm$500 c/s to $\pm$10 kc/s

Sweep rate,
continuously adjustable from . . . . . 0.01 to 25 c/s

Frequenzy sweep
(forward and return traces coincident) . . . . approx. linear with time

Frequency-marker signals (at FREQUENCY MARKER output)

for one or two (level meter Type Rel 3 D 335f) markers (no additional equipment) . . . . continuously adjustable within the sweep signal

Error after zero-cycle calibration
(f_1 spectrum-tuned) . . . . . $\pm 2 \times 10^{-5}$ $\pm$300 c/s

for further markers by modulation with an extra generator . . . . . two signals arranged symmetrically on either side of the principal signal (satellite signals), spaced apart by the frequency set on the extra generator

Waveform of signal . . . . . band with a zero crossover (high-pass signal) or pulse (low-pass signal) at the frequency to be marked

Transmitting level

Output level

without automatic control,
variable between . . . . . -70 and +10 db (-8 and +1 N)

with automatic control via the probe Type Rel 3 B 939
variable between . . . . . -10 and 0 db (-1 and 0 N)

Error

at 1 mc/s and 0 db (0 N) . . . . . ±0.2 db (±0.02 N)

Frequency response of the automatically controlled transmitting level between 10 kc/s and 15 mc/s . . . . . ±0.1 db (±0.01 N)

Maximum level variation which will be compensated for to within ±0.1 db

at zero transmitting level . . . . . ±3 db

at a transmitting level of -10 db . . . . . ±1 db

Power supply . . . . . 110, 130, 220 (230), 240 v ±10%; 47 to 60 c/s; about 180 va

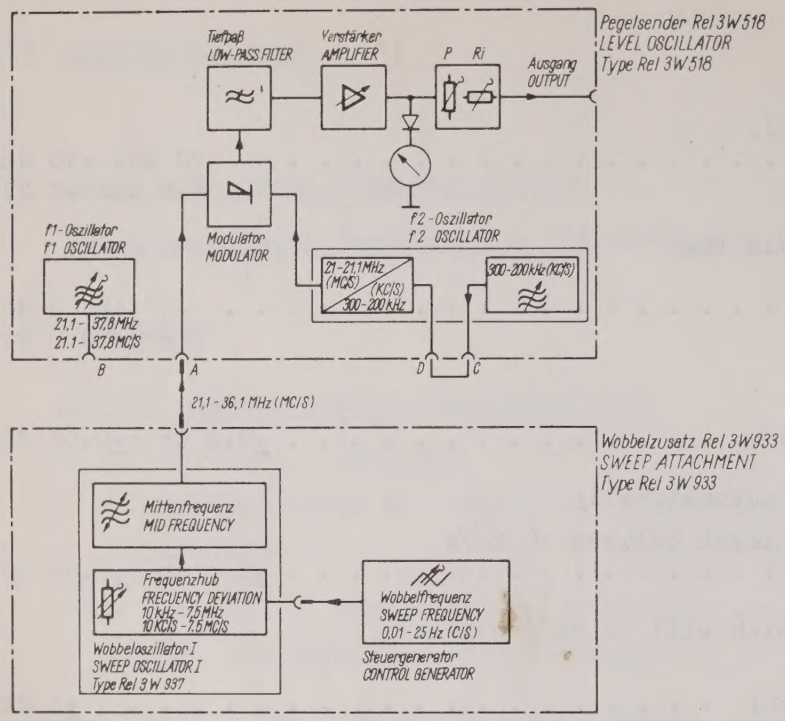


Bild 1 Blockschaltbild, Sendeteil mit Wobbeloszillator I

FIG. 1 BLOCK DIAGRAM, TRANSMITTING SECTION WITH SWEEP OSCILLATOR I

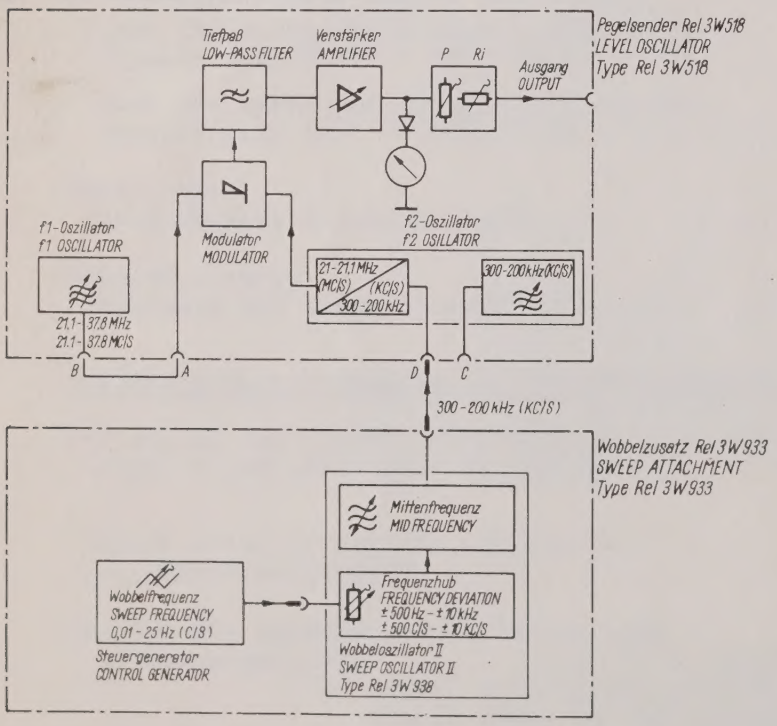


Bild 2 Blockschaltbild, Sendeteil mit Wobbeloszillator II

FIG. 2 BLOCK DIAGRAM, TRANSMITTING SECTION WITH SWEEP OSCILLATOR II

III. FUNCTIONING AND LAYOUT

1. Layout

a. The Level Oscillator Type Rel 3 W 518

In the transmitting section, the level oscillator Type Rel 3 W 518, designed on the beat-frequency principle, works together with the sweep attachment Type Rel 3 W 933. The frequency variation of the tunable f_1 oscillator unit of the level oscillator is so wide that the full frequency band of the oscillator (10 kc/s to 17 mc/s) can be set in one range without switching. The f_2 oscillator unit provides an additional control for fine tuning between 0 and 100 kc/s. The voltages of the two oscillator units are applied to a ring modulator, and the following low-pass filter accepts only the resultant difference frequency. After sufficient amplification the signal is applied to the output via the measuring field.

A crystal-controlled lock-in facility of the variable f_1 oscillator and a crystal-stabilized interpolation circuit of the f_2 oscillator give the level oscillator a high frequency accuracy and an excellent frequency stability (1).

b. The Sweep Attachment Type Rel 3 W 933

The level oscillator is converted into a sweep oscillator by supplementing it with a sweep attachment.

Owing to the divided frequency setting scheme (the two oscillators for the coarse and fine control are separately tuned) of the level oscillator the f_1 oscillator (large frequency sweeps) or the f_2 oscillator (narrow frequency sweeps) can be replaced by the corresponding sweep oscillator of the attachment. The sweep oscillators I and II, designed as slide-in cbassis, can be inserted in the sweep attachment as required (see Figs. 1 and 2).

Exacting requirements are placed on the stability of the mid-frequency and the sweep range. Especially in the case of small frequency ranges, the stability of the mid-frequency is of great importance in the measurements.

If the sweep oscillator I Type Rel 3 D 937 (for sweep ranges of $\pm$10 kc/s to $\pm$7.5 mc/s with respect to the mid-frequency) is inserted in the sweep attachment, the frequency of the level oscillator output voltage is given by the

(1) For further details see the Description of the CF level measuring setup 17 mc/s, Type Rel 3 W 518/D335.

difference between the frequency of the sweep oscillator I (f_1 = 21.1 to 36.1 mc/s) and that of the f_2 oscillator (21.1 to 21 mc/s) in the level oscillator. The mid-frequency is set on the sweep oscillator I; additional fine control by 0 to 100 kc/s on the f_2 oscillator is possible.

When the sweep oscillator II Type Rel 3 D 938 (for sweep ranges of $\pm$500 c/s to $\pm$10 kc/s with respect to the mid-frequency) is connected to the level oscillator, the f_1 oscillator unit of the level oscillator remains operated. The sweep oscillator II replaces the oscillator G2' (300 to 200 kc/s) of the f_2 oscillator unit in the level oscillator. The mid-frequency is set in crystal-spectrum steps of 100 kc/s on the f_1 oscillator, and the fine adjustment is done with the sweep oscillator II.

For sweeping the frequency, the resonant circuits of the oscillators use silicon junction diodes (varactors). When the diodes are operated in the reverse direction, their barrier layer capacitance depends on the applied control voltage. Fig.3 shows that the resultant capacitance variation is by a factor of about 5.

The capacitance variation and thus the desired frequency variation, controlled by varying the diode bias, takes virtually no power. Compared to a ferrite-reactor sweep element, the varactor has a relatively low temperature coefficient and is free from any further disturbing characteristics (such as the hysteresis effect of a ferrite reactor).

The control generator in the sweep attachment supplies a symmetrical triangular voltage for the control of the varactor diodes. Its frequency determines the sweep rate (number of frequency sweeps per second), and its amplitude the sweep range (variation of the swept frequency as referred to the mid-frequency). The two of them can be set independently, in steps and continuously.

As the frequency f of a varactor-controlled oscillator approximately follows the relation

$$f \approx \frac{1}{\sqrt[4]{U_{st}}}$$

where U_{st} is the control voltage of the varactor, the frequency sweep would be considerably nonlinear for larger sweep ranges and a linearly varying control voltage. A network has therefore been interposed between the control generator and the varactor diodes for shaping the control voltage so that an essentially linear frequency sweep is achieved.

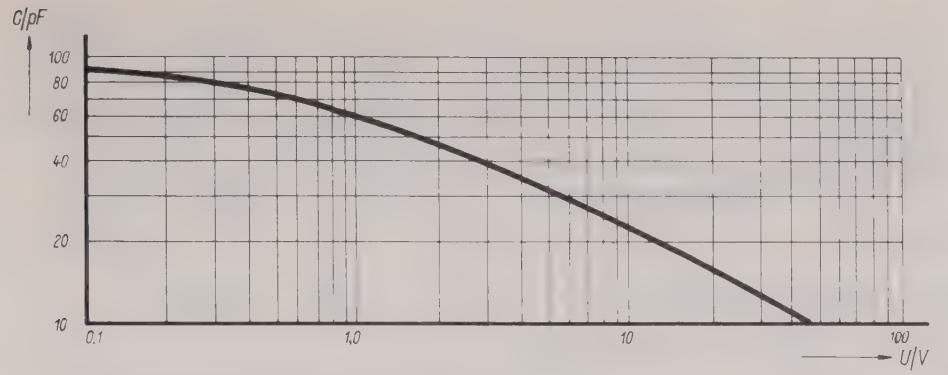


FIG. 3 CHARACTERISTIC OF A VARACTOR DIODE

Moreover, for the horizontal deflection, the triangular control voltage is applied to the level tracing receiver with the same magnitude, irrespective of the sweep range. This results in a frequency sweep of the oscillator voltage that is synchronous with the horizontal deflection over the full width of the picture screen, irrespective of the sweep rate.

Two methods, suitable for small and large sweeps, are available for frequency marking purposes. In the case of large frequency sweeps, pulses from the sweep attachment gate on frequency marker lines in the level tracing receiver. Via a low-pass filter these pulses are derived from the beat frequency formed by modulating the sweep oscillator voltage with that of the oscillator not required for swept operation. The frequency of this oscillator determines the position of the marker in the sweep signal; it can be manually adjusted and its frequency can be read off the scales of the level oscillator $(f_1 + f_2)$. The accuracy of the frequency marking therefore equals the frequency accuracy of the level oscillator.

As in the case of narrow frequency sweeps the pulse coupled out via the low-pass filter, when taken in proportion to the sweep range, would be too wide, it can be extracted via a high-pass filter in this case. The resultant frequency marker signal is an amplitude-modulated band with a zero-crossover at the frequency to be marked.

Frequency-dependent amplitude variations of the transmitting voltage can be compensated for by a regulating amplifier mounted in the sweep attachment. For this purpose the transmitting voltage is taken directly ahead of the specimen with the Type Rel 3 B 939 probe and rectified and compared

with a constant voltage in the regulating amplifier. The resultant regulating voltage is then applied to the modulator Md3 of the level oscillator to modulate the signal voltage of the oscillator so that the transmitting voltage at the test point will remain almost constant.

2. The Sweep Oscillators

a. Sweep Oscillator I Type Rel 3 W 937 for sweep ranges of +10 kc/s to +7.6 mc/s

The sweep oscillator I (frequency range 21.1 to 36.1 mc/s) works in a Hartley circuit. The resonant-circuit coil is designed as a variometer, consisting of a ceramic coil with an adjustable brass/ferrite core (Fig.4).

The desired mid-frequency of the oscillator is set by varying the inductance of the variometer coil. The variable capacitance of the resonant circuit consists of two varactor diodes. Its capacitance variation, which depends on the control voltage applied, determines the sweep range (frequency variation referred to the mid-frequency) of the oscillator (Fig.5).

To linearize the frequency sweep as required, the triangular control voltage, which is symmetrical about 0 v, is accordingly shaped by a network.

The circuit diagram of this sweep range equalizer networks is shown in Fig.6, the waveform of the control voltage in Fig.7. During the positive alternation the diode Gr1 is forward-biased and connects the network Gr2 to 4, R12 and V1, V2 in parallel to the voltage divider resistor R10.

The resistance of the varistors V1 and V2 decreases as the positive voltage increases, and the diodes Gr2 and Gr3/Gr4 become conducting successively after the Zener voltage has been reached. The control voltage at the varactor diodes therefore increases exponentially. During the negative alternation Gr5 connects the resistor R14 and V3 in parallel to the divider resistor R11. The voltage rise at the varactor diodes therefore levels off as the negative voltage increases.

If the control voltage at the varactor diodes and hence their capacitance variation remain the same despite a variation of the mid-frequency, the frequency sweep will also vary linearly with the mid-frequency, i.e. $\Delta f/f$ = const.

For setting the sweep range independently of the mid-frequency, (Δf = const.), the varactor control voltage is varied along with the mid-frequency via the potentiometer P5 coupled to the same control knob.

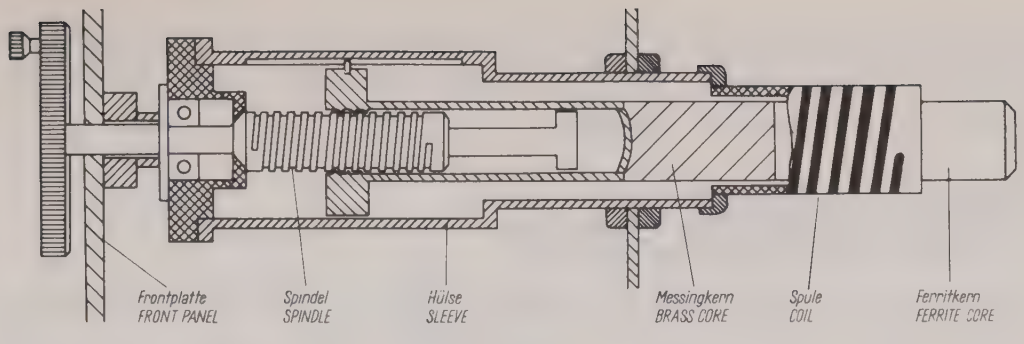


Bild 4 Aufbau des Variometers

FIG. 4 LAYOUT OF THE VARIOMETER

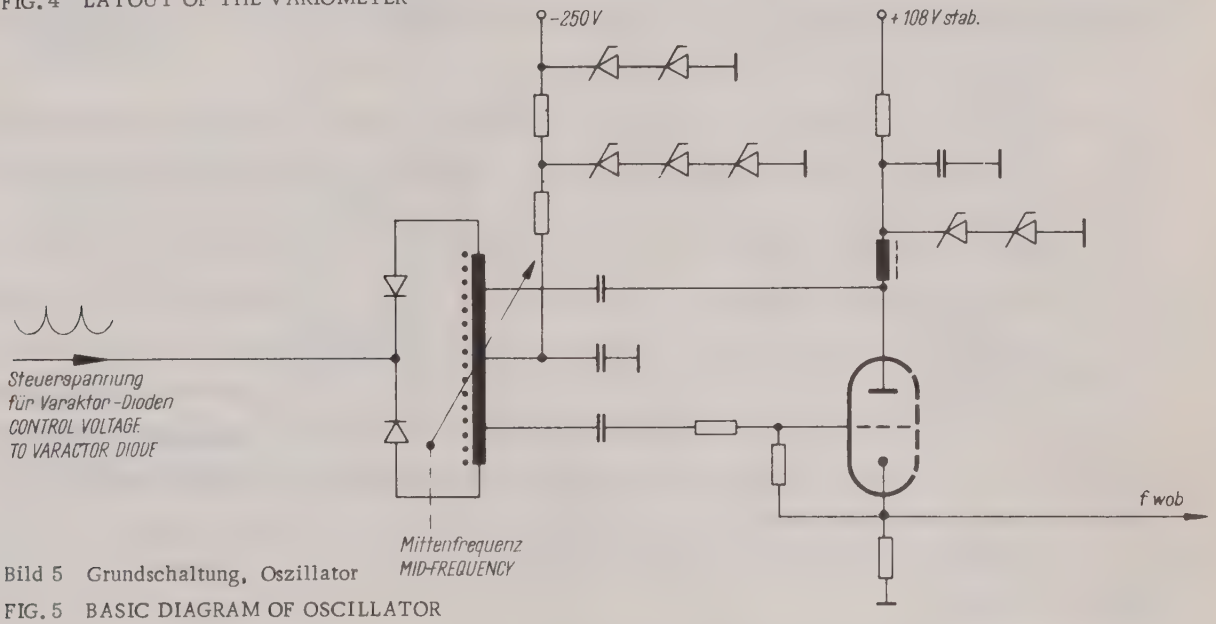


Bild 5 Grundschaltung, Oszillator

FIG. 5 BASIC DIAGRAM OF OSCILLATOR

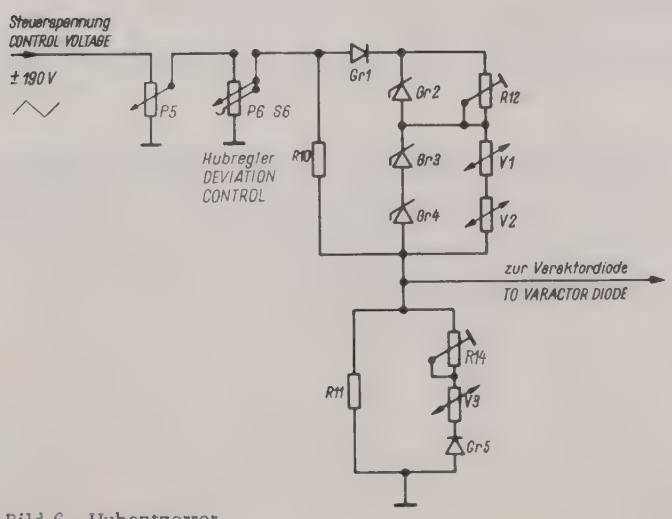


Bild 6 Hubentzerrer

FIG. 6 SWEEP-RANGE EQUALIZER

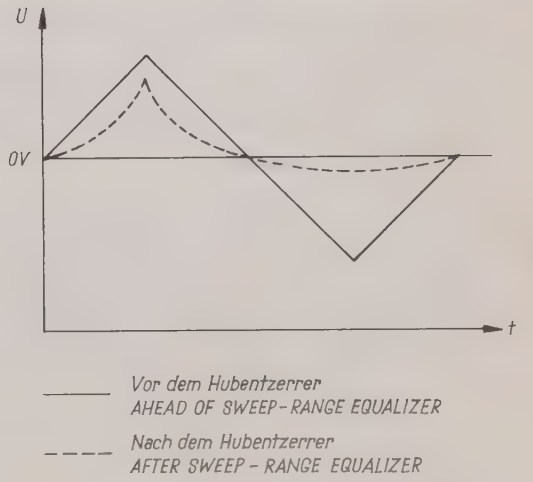


Bild 7 Spannungsverlauf

FIG. 7 VOLTAGE AS A FUNCTION OF FREQUENCY

To make the mid-frequency highly stable, the anode and heater voltages of the oscillator tube have been carefully stabilized as has been the fixed negative bias for the varactor diodes.

b. Sweep Oscillator II Type Rel 3 W 938
for Sweep Ranges of +500 c/s to +10 kc/s

For small sweep ranges the sweep oscillator II takes over the function of oscillator G2' (300 to 200 kc/s) in the level oscillator. Again, a varactor diode is used as sweep element. As the sweep range/mid-frequency ratio is considerably lower than in the case of sweep oscillator I, the mid-frequency can be capacitively set in this case as well (Fig.8).

The oscillator is designed as an R-C generator whose frequency-determining part is a Wien-Robinson bridge. Its mid-frequency can be varied from 300 to 200 kc/s with the variable double-section capacitor C3. As a controlled capacitance, the varactor diode Gr5 is connected in parallel to one half of the controllable capacitor. Its operating point is fixed by a stabilized bias. The varactor diode, like that of the sweep oscillator, is controlled by the triangular voltage from the sweep attachment. For narrow-range sweeping ($\pm$500 c/s to $\pm$10 kc/s), the capacitance variation of the varactor diode required must be considerably smaller than in the case of larger ranges, so that a simple shaping network (Gr1, R7, R2) in the control-voltage circuit (see the circuit diagram Rel str 3 W 938 En) suffices to linearize the frequency sweep.

To secure a sweep range that is constant irrespective of the mid-frequency, this oscillator, too, is so designed that, via the potentiometer P7, the varactor control voltage is adjusted along with the mid-frequency set in a particular case.

The varactor diode causes an unsymmetrical unbalance of the Wien-Robinson bridge and hence gives rise to incidental AM compensated for by the following amplifier. The stabilized anode voltage and a regulated DC heating system contribute to the high stability of the mid-frequency.

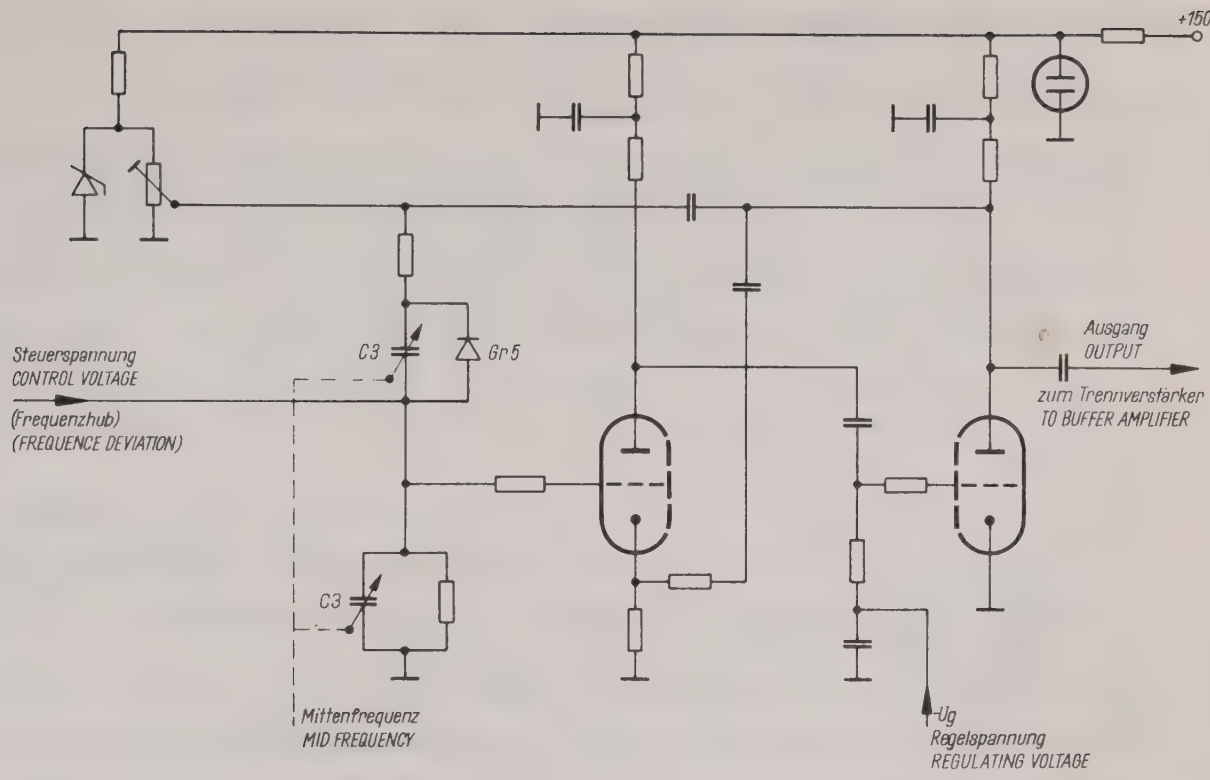


Bild 8 Grundschaltung, Wobbeloszillator II

FIG. 8 BASIC DIAGRAM OF THE SWEEP OSCILLATOR II

3. Generating the Frequency Marker Signals

a. For Large Sweep Ranges of about +50 kc/s to +7.5 mc/s (Fig.9)

When sweep oscillator I is inserted in the sweep attachment, the spectrum-tuned f_1 oscillator unit of the level oscillator which is not required for the generation of the transmitting voltage is used to generate the markers. Its frequency and the sliding frequency of the sweep oscillator are applied through buffer stages to modulator Md1 of the sweep oscillator subassembly. If the frequency set on the f_1 oscillator is within the sweep range adjusted, a zero crossover will occur whenever the frequencies at the modulator output agree.

The resultant beat notes, which are symmetrical about the zero crossover, are accepted up to a certain frequency determined by the following switched two-stage R-C low-pass filter (Fig.10). The frequency marker pulse formed out of these beat notes, after having been amplified and limited, is applied to the picture receiver, where it is used to gate on the frequency marker lines. As the frequency marker signal should be very narrow compared to the sweep range, adjustable within wide limits (1 to 2% of the range), means must be provided for adapting the pass band of the low-pass filter to the frequency range. This is done by switching the capacitors in fixed steps (up to a factor of 1:100 or continuously via a double potentiometer) so that the cutoff frequency of the low-pass filter can be continuously shifted between 100 c/s and 10 kc/s. The position of the frequency marker can be read off the scales ($f_1 + f_2$) of the level oscillator.

b. For Sweep Ranges of +500 c/s to about +50 kc/s

Generating narrow frequency markers by means of a variable low-pass filter involves some difficulty, because the filter is only some cycles wide (1 to 2% of the sweep range $\hat{=}$ 10 c/s for a sweep range of $\pm$500 c/s) and the sweep rate would have to be disadvantageously low on account of the long transient time of such a filter. Therefore a method is used displaying a frequency-modulated signal directly on the picture tube, the zero beat of the signal serving as a frequency marker in the level tracing receiver.

For this purpose the frequency band of the sweep oscillator modulated with the frequency of the idle level oscillator unit is applied from the output of the modulation stage to a high-pass filter (Fig.11), which suppresses low-frequency amplitudes at either side of the zero beat, so that the picture

tube shows a well readable zero. The frequency of the marker thus represented is likewise given by the sum of the settings $f_1 + f_2$ on the level oscillator.

Like the pass-band of the low-pass filter, the stop-band of the high-pass filter can be adapted to the sweep range.

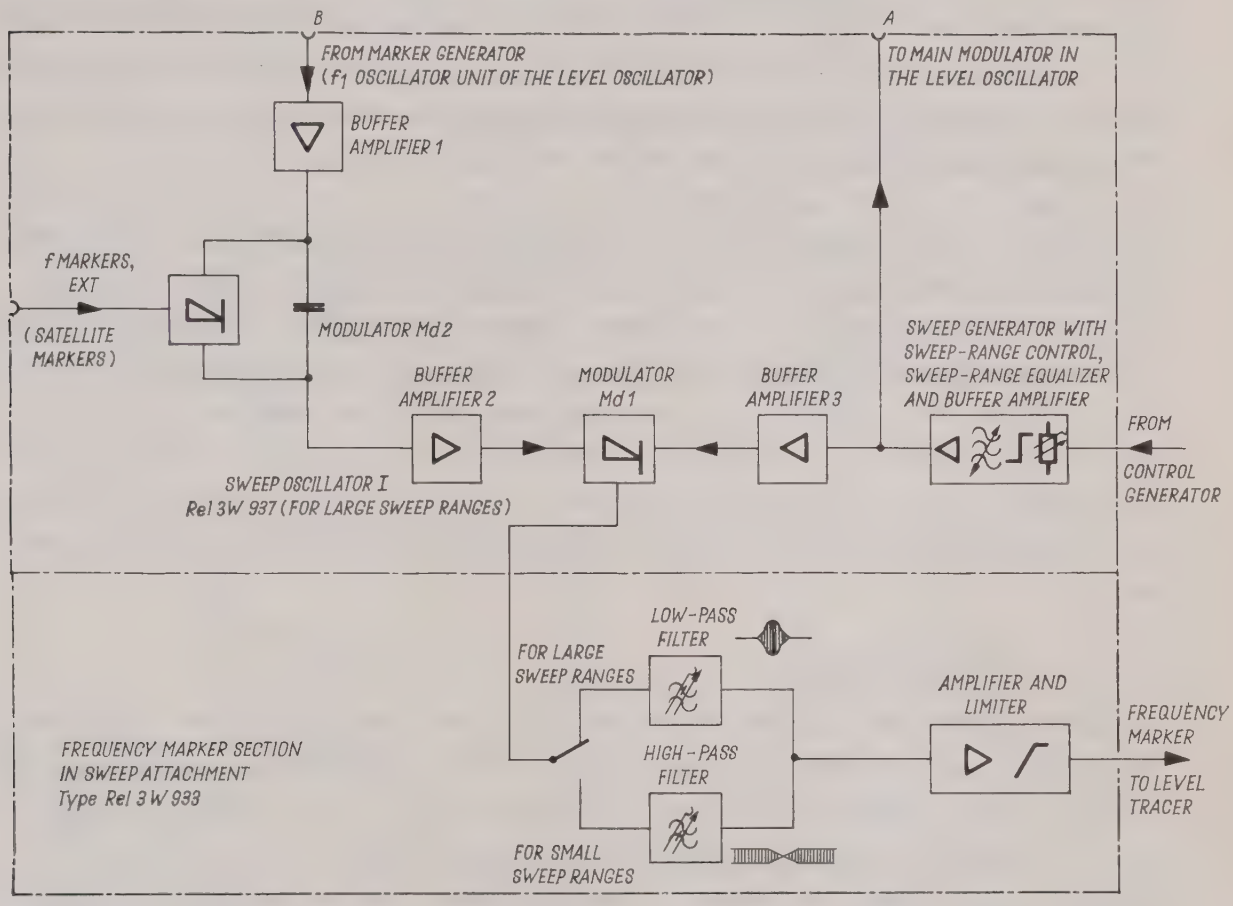


FIG. 9 BLOCK DIAGRAM, FREQUENCY MARKER SIGNAL FOR WIDE SWEEP RANGES

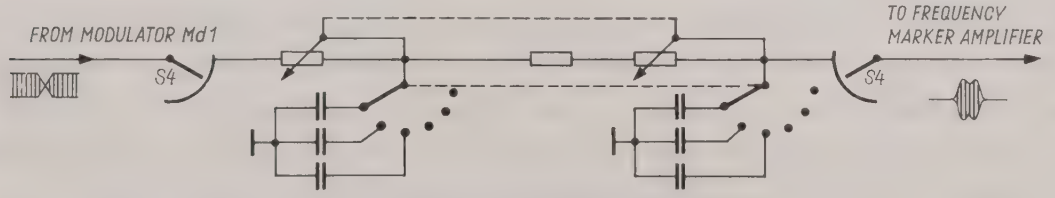


FIG. 10 BASIC DIAGRAM OF THE LOW-PASS FILTER

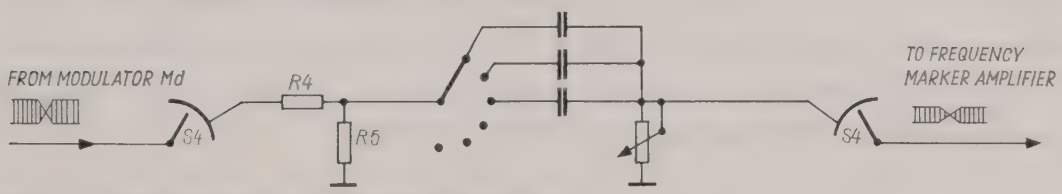


FIG. 11 BASIC DIAGRAM OF THE HIGH-PASS FILTER

4. The Frequency Marker Amplifier (Fig.12)

a. When large sweep ranges (in excess of ±50 kc/s) are employed, the frequency marker signal from the low-pass filter is amplified as a first step. The following minimum-value limiter, consisting of two silicon diodes connected in parallel with opposing polarities (Gr1 to Gr4) and the resistor R14, suppresses the low voltages in the transition region of the filter to shorten the rise time. The frequency marker signal is further amplified in the three-stage final amplifier and limited and applied to the output jack "b" as a frequency marker pulse for the level tracing receiver.

b. When small sweep ranges (less than ±50 kc/s) are employed, the high-pass filter is brought into circuit. It passes the frequency-modulated band, lowering the amplitude of the signal symmetrically about the zero crossover. The divider R4, R5 reduces the input voltage. After the high-pass filter has been cut in, the diodes 1 to 4 are bypassed with the same switch (S4), so that no limiting of low voltage is required. As the output voltage of the high-pass filter is considerably lower than that of the low-pass filter, the frequency-modulated band is not limited in the final stage of the marker amplifier.

5. Extra Frequency Markers

In addition to the extremely accurate frequency marker derived from the idle oscillator unit of the level oscillator, further frequency markers arranged symmetrically about that marker can be generated. Fig.9 shows that modulator Md2 is located between the buffer amplifiers 1 and 2. The application of an external AC voltage to modulator Md2 modulates the voltage of the oscillator unit in the level oscillator with that of the additional auxiliary oscillator so that a composite-frequency signal, consisting of the fundamental of the oscillator and the sum and difference frequencies originating in the modulation process reach the modulator 1. The three zero crossovers that appear when the sweep oscillator is swept through its range provides three frequency marker signals at the output of modulator Md1.

The spacing of the two extra frequency markers arranged symmetrically about the master marker equals the frequency of the auxiliary oscillator. When the master marker is changed (frequency controls f_1, f_2 of the level oscillator), these two markers will accompany it as "satellites".

If, in exceptional cases, more than three frequency markers should be desirable, two more markers can be provided symmetrically about each of the satellites by modulation with the voltage of the auxiliary oscillator.

A frequency marker spectrum can be generated by applying a pulse voltage to modulator Md2. The spacing between the individual frequency markers corresponds therefore to the pulse repetition frequency.

Two vertical marker lines can be added to the display of the level tracing receiver; they are generated independently of the sweep frequency and can be shifted across the full width of the screen. In addition, they can be calibrated against the well-defined frequency marker from the transmitting section so that a three-frequency scale can be provided without using any additional oscillator. A variable calibrated fourth marker can be supplied by the idle oscillator of the level meter (if the measuring setup contains such an oscillator, which is not required for wideband reception).

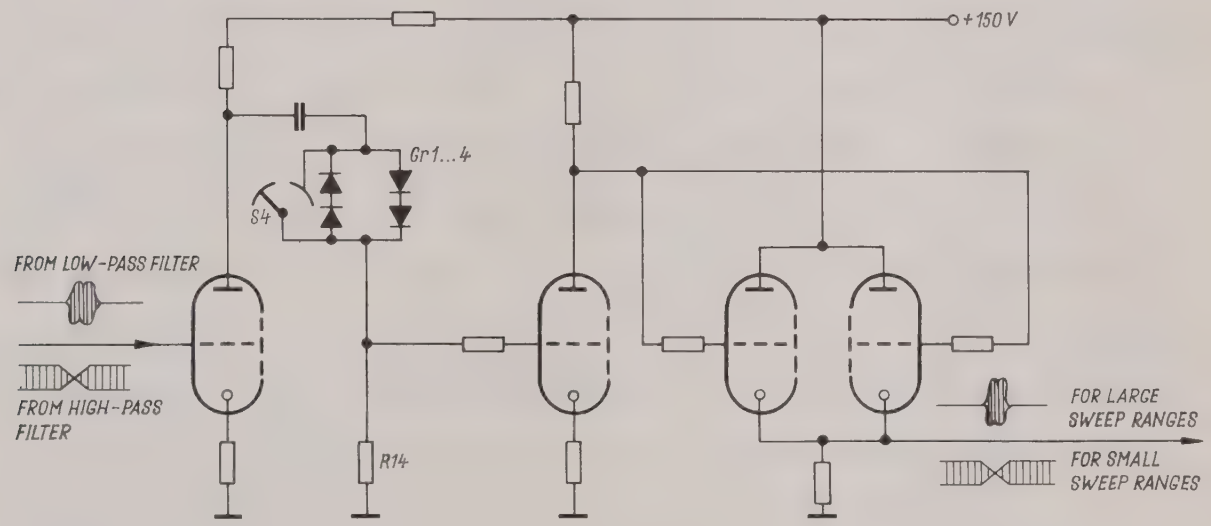


FIG. 12 BASIC DIAGRAM OF THE FREQUENCY MARKER AMPLIFIER

6. The Control Generator (see Fig.13)

The control generator furnishes a balanced, triangular AC voltage (rise and fall time equal) for the control of the varactor diodes of the sweep oscillator and for the time base of the picture tube. This secures synchronism between the swept frequency and the time base of the picture tube, the times for the forward and return traces being equal. An excessive sweep rate is indicated by the fact that the two patterns no longer agree. This feature always permits the highest possible sweep rate to be set. With S3 the sweep circuit of the generator can be interrupted and switched for MANUAL CONTROL.

When so switched, the circuit works as follows:

Depending upon the position of potentiometer P1 MANUAL CONTROL, a negative voltage is applied from voltage divider 3 to the grid of tube 11. When this voltage is set for -270 v, the voltage drop across R19 causes a grid/cathode potential of about 0 v to develop at tube 11, i.e. the tube is opened for current to flow. The cathode of tube 10 has then applied to it the maximum negative voltage, which is also run to the output jacks. Due to the voltage drop across R13 the grid of tube 10 is negative with respect to the cathode, i.e. tube 10 is blocked. When the grid/cathode potential of tube 11 is made negative by varying P1, the anode current of this tube goes down. The negative voltage at the cathode of tube 10 goes down simultaneously, and the voltage drop across R13 becomes smaller, while the anode current of tube 10 increases. The output voltage (cathode of tube 10) passes through zero volts and finally reaches a positive maximum when tube 11 is blocked (-310 v applied to the grid) and tube 10 is fully open. Switching in the sweep circuit for the "automatic frequency sweep", cuts out voltage divider 3. The negative voltage is then applied from divider 2 to the grid of tube 11. When "automatic frequency sweep" is set, voltage divider 1 is also connected via divider R7, 8, 9 to the output voltage. Part of the latter is applied via the variable resistor to two oppositely polarized and biased diodes. When the applied voltage exceeds the positive or negative bias, the corresponding diode will become conducting and the polarized relay E transfer. The grid voltage for tube 11 is switched at voltage divider 2 via the transfer contacts of this relay.

To provide a triangular output voltage, the square wave voltage from divider 2 charges and discharges one of the capacitors C4 to C8 through the series resistors P2, R30. The triangular voltage that develops across the capacitor

is applied to the grid of tube 11. The frequency of the triangular voltage, determined by the time constant of the respective R-C network, can be finely tuned in a continuous way with the variable (series) resistor P2.

Via a differentiating network the square wave voltage from divider 2 is also applied to one output jack. Along with the triangular voltage it is run to the level tracing receiver where it is available at a jack for operation of the standard/unknown alternate-presentation switch.

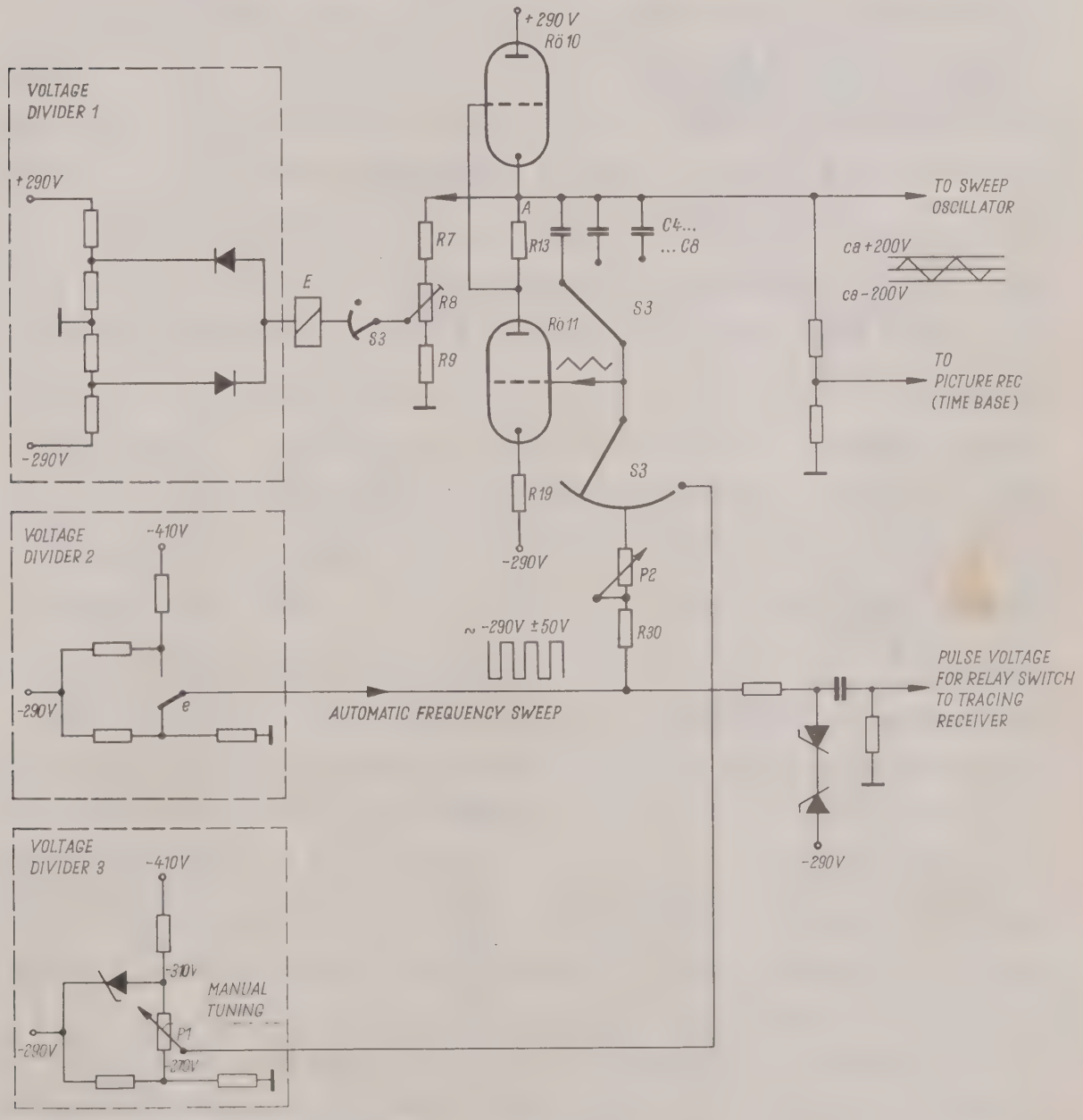


FIG. 13 BASIC DIAGRAM OF THE CONTROL GENERATOR

7. The Regulating Amplifier (see Fig.14)

In order to exclude measuring errors due to amplitude/frequency response or to other transmitting level variations of the measuring setup as far as possible, the transmitting section of the measuring setup provides a regulating device. Regulation of the transmitting voltage is advisable especially when wide sweep ranges are involved, as the amplitude/frequency response may then be inadmissibly high.

The regulator is a proportional controller, i.e. each deviation from the nominal transmitting EMF is associated with a definite value of the manipulated variable at the controller output. The controller consists of the regulating amplifier in the sweep attachment and the Type Rel 3 B 939 probe. The transmitting voltage is run on a low-impedance basis (Zi $\cong$ 0 Ω) to the probe, which should be connected as close to the specimen as possible. As the regulation refers to the variation of the transmitting voltage at the probe, any amplitude/frequency response between the level oscillator and the specimen under test, apt to occur as a result of frequency-dependent variations of the characteristic impedance of the connecting cord, for one, are precluded. In the probe a DC voltage is obtained from the transmitting EMF, the magnitude to be manipulated, via crystal diodes for application via a line to the regulating amplifier. The source impedance (75 Ω) of the transmitting voltage is formed by a series resistance in the probe. Moreover, a zero-ohm output is available, so that source impedances of a different value can be brought in circuit, if required. The transmitting voltage is regulated ahead of the source impedance to secure that variations of the transmitting terminal voltage are not compensated for by a frequency-dependent input impedance of the specimen, as this would lead to measuring errors.

In the regulating amplifier (branch A) the DC voltage from the probe controls the triode (tube 14). The voltage is amplified and applied via DC coupling to the grid of the final tube (triode, tube 15). The stabilized DC voltage in branch 3, which can be regulated with P4 and P5, is the reference voltage (nominal voltage). On its further way this voltage is amplified in the same manner as in branch A. The difference between the anode voltages at the final tubes in the branches A and B is the manipulated variable.

The ring modulator for "frequency modulation" in the level oscillator is used as regulating unit; it varies the signal voltage for the beat-frequency modulator as a function of the manipulated variable (modulation), so that level variations at the probe are cut down to low values.

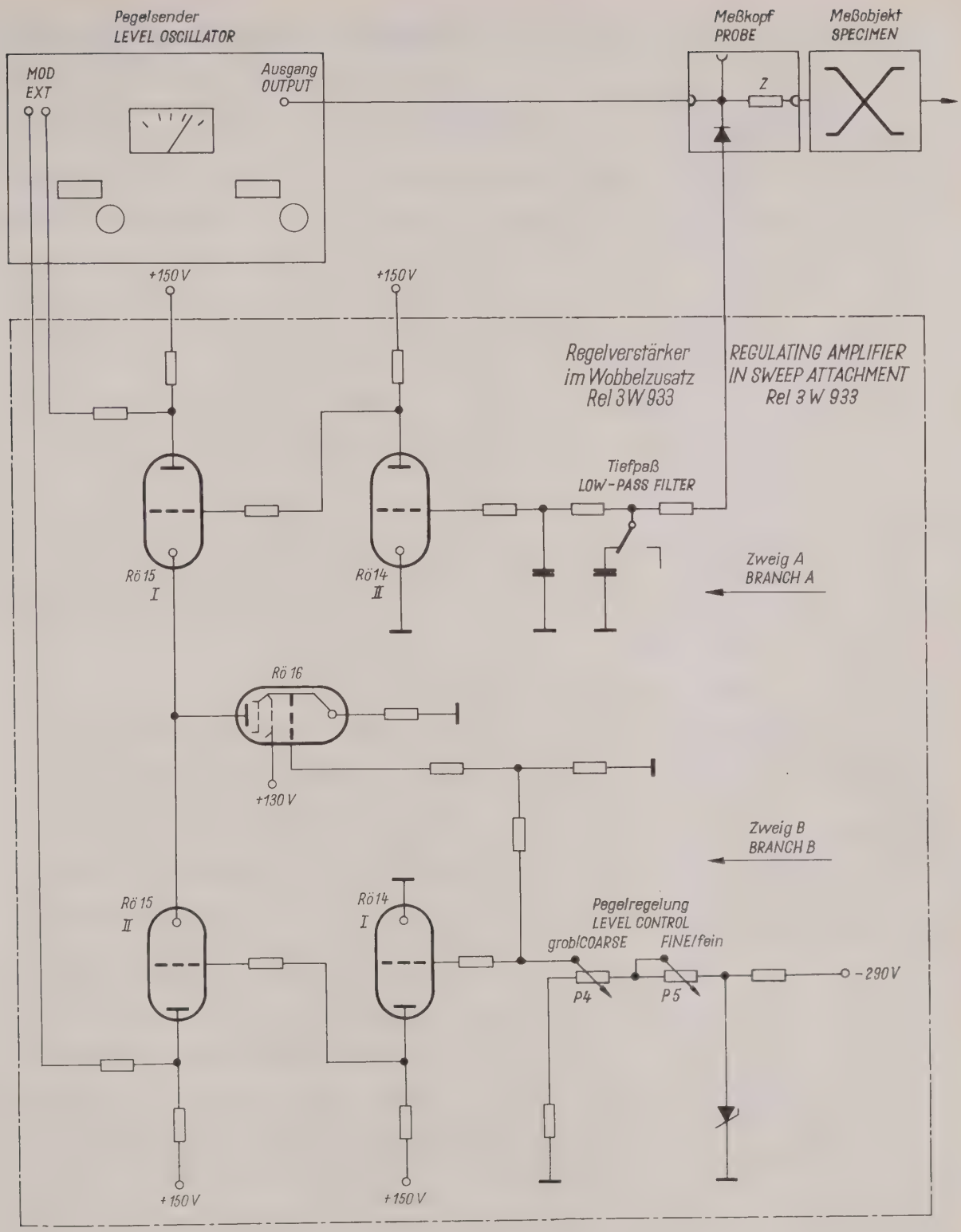


Bild 14 Grundschaltung, Regelverstärker

FIG. 14 BASIC DIAGRAM OF THE REGULATING AMPLIFIER

To guarantee optimum regulating performance, the nominal voltage must be adjusted with P4 and P5 so that the mean value of the transmitting voltage is the same, irrespective of whether the regulation is on or off. To this end the regulating circuit at the input of the regulating amplifier is interrupted, the desired transmitting level set on the level oscillator, and the transmitting voltage of the regulating amplifier readjusted to the original level after the regulating circuit has been closed.

The switched low-pass filter at the input of the regulating amplifier (branch A) performs the following function: in the case of sweep ranges having their lower limit between 10 and 100 kc/s, the low-pass filter (a pi-circuit with a high time constant) prevents the instantaneous amplitude values of a low-frequency sinewave from causing the regulation to operate. On the other hand, the time constant must not be high enough for preventing a regulation of quick variations in the amplitude/frequency response in the case of sweep ranges having their lower limit above 100 kc/s. In the latter case the low-pass filter must therefore be switched to the low time constant. Tube 16 in the cathode arm of the final tubes stabilizes the mean anode current of these tubes.

The circuit details omitted in Fig.14 are shown in the circuit diagram Rel str 35 W 545 En of the Circuit Data Folder. Relay C, switching arm A of the amplifier to the nominal voltage as long as the connection to the probe is interrupted, prevents the input tube from being overloaded. In addition, relay C disconnects relay D from the exciter voltage. When there is no connection to the level oscillator, relay D disconnects the anode voltages of the final tubes from the output jacks. The diodes between the two anodes of tube 14 limit the manipulated variable should the nominal voltage be set incorrectly. Such limiting is required as the modulator (the regulating unit) has a reversal point in its characteristic. Beyond this point the operating point can no longer be set correctly.

The operating level range of the regulating circuit includes transmitting levels from 0 db to -10 db. Smaller transmitting levels require an attenuator to be interposed between the probe and the specimen under test.

IV. DESIGNATIONS, DIMENSIONS, AND WEIGHTS

Description	Designation	Dimensions in mm	Approx. Weight in kg
Sweep attachment	Rel 3 W 933b1a	556x258x417	20
Accessories			
3 tubes	E 235 L	-	-
4 tubes	6 AK 5 W	-	-
6 tubes	CCa	-	-
3 stabilizer tubes	85 A 2	-	-
2 coaxial connecting cords .	Rel ltg 592a	-	-
Required for Operation			
1 sweep oscillator I	Rel 3 W 937b1a	226x205x219	4.5
Accessories to the sweep oscillator I:			
5 tubes	CCa	-	-
or			
1 sweep oscillator II . . .	Rel 3 W 938b1a	226x205x219	4.5
Accessories to the sweep oscillator II:			
3 tubes	CCa	-	-
1 stabilizer tube	85 A 2	-	-
1 level oscillator	Rel 3 W 518/3 D 335	556x394x307	30
Accessories to the level oscillator	see Rel 3 W 518/ 3 D 335 En		
Optional for the Sweep Oscillator			
1 probe	Rel 3 B 933b1a	133x72x70	0.3
Accessories to the probe:			
1 connecting cord	Rel ltg 598d	-	-

I. PREPARATION

A. Power Supply

The devices leave the factory adapted for connection to AC mains of 220 v. If they are to be operated from other AC mains, the chassis must be taken out of the casing and their voltage adjusters be switched for the available mains voltage:

level oscillator Type Rel 3 W 518:
switch S6 on top of the power supply subassemblies near the power transformers;

sweep attachment Type Rel 3 W 933:
switch S2 at the rear of the device above the power transformer Tr1 in the power supply unit.

For operation on 110-v or 130-v mains: insert a 2-amp fuse link in the level oscillator Type Rel 3 W 518, a 4-amp fuse link in the sweep attachment Type Rel 3 W 933.

The Safety Code of the Verein Deutscher Elektrotechniker (Association of German Electrical Engineers (VDE)) specifies that mains-powered devices must be fitted with a protective-conductor terminal if their touch potential can exceed 65 v with respect to ground in the case of a fault.

For this reason the devices have a power cord with protective conductor and protective-contact plug (Schuko three-wire plug) for insertion into a power outlet with protective ground (Schuko outlet). The connector and the wire cross section of the non-current carrying protective conductor must be equivalent to those of the current-carrying conductors.

If need arises for replacing the Schuko plug with another (locally customary) plug with protective contact, connect the three wires (red, grey and black) of the power cord as follows:

With non-polarized connector systems:

red wire to the protective conductor terminal

grey and black wires to the current-carrying terminals.

With polarized connectors in mains with phase and neutral:

red wire to the protective conductor terminal,

grey wire to the neutral terminal

black wire to the "phase" terminal.

The devices have also an extra jack-top screw terminal on the front panel, which is connected to chassis ground.

B. Layout

Place the equipment units so that the front panels are vertical. The ventilation openings on top of the casings must be free. Putting the level oscillator onto the sweep attachment is permissible.

C. Selecting the Sweep Oscillator

Insert either the sweep oscillator slide-in chassis I Type Rel 3 W 937 (for sweep ranges of ±10 kc/s to ±7.5 mc/s) or the sweep oscillator slide-in chassis II Type Rel 3 W 938 (for sweep ranges of ±500 c/s to ±10 kc/s) into the sweep oscillator Type Rel 3 W 933, depending upon the particular measuring job involved, and establish coaxial connections A, B (sweep oscillator I) or C, D (sweep oscillator II) to the level oscillator (2 x Rel ltg 592a). Withdraw the respective connector (A-B or C-D) from the level oscillator.

D. Regulating the Transmitting Voltage

At the maximum sweep range (±7.5 mc/s) the frequency response of the amplitude may be up to 0.5 db (0.05 N) at the output of the oscillator. To this add the frequency response of the lead to the specimen under test resulting from mismatch. (The frequency response decreases as the sweep range becomes smaller.)

With exact measurements, unless they are comparison measurements, automatic regulation of the transmitting voltage is therefore advisable in the case of wide sweeps. To this end the Type Rel 3 B 939 measuring probe is required in addition to the regulating amplifier mounted in the sweep attachment. The probe should be connected as closely ahead of the specimen as possible, as the regulation refers to this point.

The following connections are additionally required for the regulation: from the probe to jack E of the sweep attachment, and from jack F of the sweep attachment to jack F of the level oscillator (Type Rel ltg 546 cord).

II. CALIBRATING AND SETTING

A. Sweeping Large Ranges (±8 kc/s to ±7.5 mc/s) with the sweep oscillator I slide-in chassis Type Rel 3 W 937 (Fig.1).

1. Setting the Mid-Frequency

Set the desired mid-frequency on the MC/S scale with L1 (MID-FREQUENCY control knob). Incremental adjustment is possible with the FINE TUNING control f2 of the level oscillator.

2. Setting the Sweep Range

Set the desired sweep range coarsely with the step switch S6 (SWEEP RANGE double control knob). Fine adjustment within the preset coarse range is done with P6 with the aid of the screen trace displayed by the receiver. Use the frequency markers for setting the mid-frequency and the sweep range exactly.

B. Sweeping Small Ranges (±500 c/s to ±10 kc/s) with the sweep oscillator II Type Rel 3 W 938 (Fig.2).

1. Setting the Mid-Frequency

The mid-frequeney is the sum of the frequency f1 (mc/s) of the level oscillator and f2 (kc/s) of the sweep oscillator.

2. Setting the Sweep Range

It can be continuously set between ±500 c/s and ±10 kc/s with the FREQUENCY RANGE control P8. It is advisable to operate the control first to the CW stop (sweep range ±10 kc/s) and then to suitable narrow down the range by reference to the screen trace displayed by the level tracing receiver with the aid of the frequency markers. Adjust the MID-FREQUENCY control C3 and the FREQUENCY RANGE control P8 so that the desired frequency range is spanned.

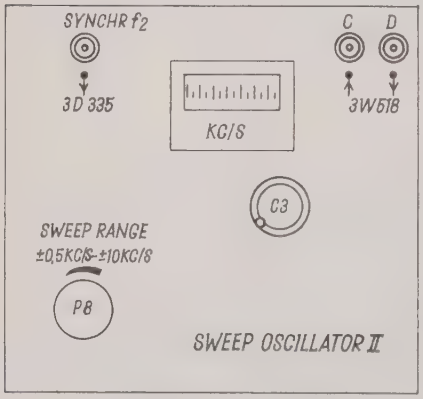


FIG. 1

SWEEP-OSCILLATOR I SLIDE-IN CHASSIS
Type Rel 3 W 937, CONTROLS

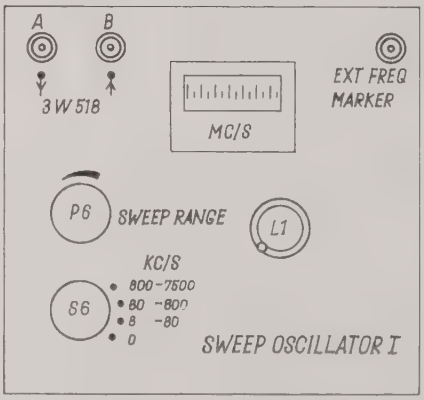


FIG. 2

SWEEP-OSCILLATOR II SLIDE-IN CHASSIS
Type Rel 3 W 938, CONTROLS

C. Setting the Sweep Rate

The sweep rate, i.e. the number of sweeps (upward and downward) per second, can be set between 0.01 and 25 c/s with the double kontrol knob SWEEP RATE; S3 is for step-by-step and P2 for continuous adjustment within the individual step (see Fig.4).

Start with a high sweep rate, reducing it until the upward and downward sweeps of the displayed curve agree. This measure enables the operator to set the highest possible sweep rate, as transients betray themselves by failure of the upward and downward sweeps to agree.

In the switch position 0 (S3 at the left-hand stop) the sweep rate is 0. With the MANUAL CONTROL P1, the rate can then be set manually within the sweep range selected.

D. Frequency Markers in the Case of Large Sweep Ranges ($\pm$50 kc/s to $\pm$7.5 mc/s)

1. Setting the Frequency

The variable lock-in oscillator G1 of the level oscillator, which is not required for swept operation, is used to generate the frequency marker signal. For frequency markers of high accuracy, set the generator with the lock-in facilities on. The frequency relation of the marker signal to the measuring curve can be read off the two frequency scales ($f_1 + f_2$) of the level oscillator. Note that a variation of the f_2 control also varies the sweep voltage (see section A.1.).

Two further frequency markers arragend symmetrically about the master marker (satellites) can be generated with the aid of an extra oscillator. To this end connect the output of this oscillator to the FREQUENCY MARKERS EXTERNAL jack E of the sweep oscillator and set the desired frequency in accordance with the spacing to the master marker. Transmitting voltage required about 1.0 v.

By amplitude-modulating the external oscillator, additional frequency markers besides the frequency marker satellites can be generated.

2. Setting the Marker Width

A clear frequency evaluation of the curve traced out requires the frequency marker line to be as narrow as possible. It should not exceed 1% to 2% of the sweep range. This setting is done on the OPTIMUM IN SWEEP RANGE double control knob (S4,P3) on the frequency marker section of the sweep attachment and can be adapted stepwise and continuously to the sweep range set on the sweep oscillator I (see Fig.3).

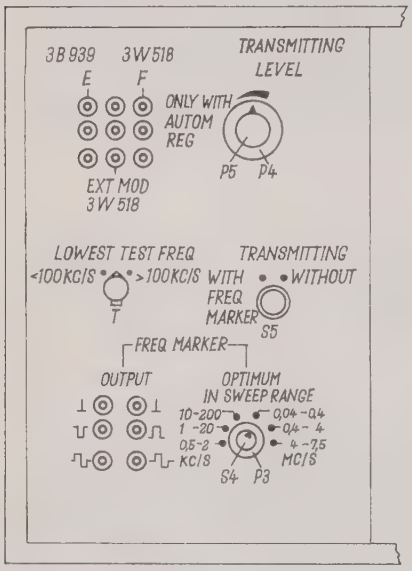


FIG. 3

SWEEP ATTACHMENT Type Rel 3 W 933, LEFT HALF: FREQUENCY MARKER CONTROLS

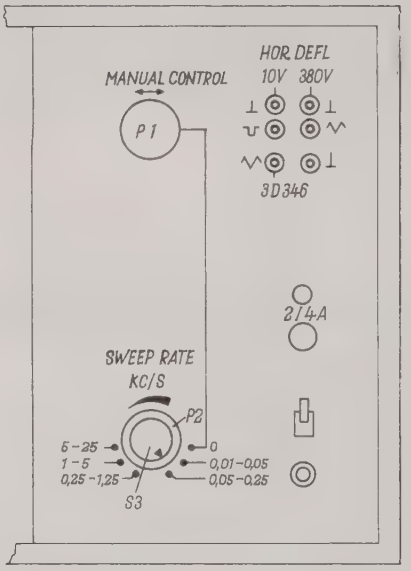


FIG. 4

SWEEP ATTACHMENT Type Rel 3 W 933, RIGHT HALF: SWEEP-RATE CONTROLS

E. Frequency Markers in the Case of Sweep Ranges between ±10 kc/s and ±50 kc/s

In this range the frequency markers can always be represented as lines as they can in the case of sweep ranges between ±100 kc/s and ±7.5 mc/s, but the increasing width of the marker in the case of small sweep ranges makes the determination of the frequency more inaccurate. It is therefore better to select the frequency marker signal through the high-pass circuit and to display it on the screen as an envelope curve with a zero crossover at the frequency to be marked.

1. Setting the Frequency

The frequency of the measuring curve at which the marker lies corresponds to the frequency $f_1 + f_2$ set on the level oscillator. As the mid-frequency of the sweep voltage is shifted with f_2 (the frequency marker remains stationary on the screen, while the sweep curve is shifted), the direct calibration of the two shiftable vertical marker lines generated in the level tracing receiver can only be performed with the f_1 control. In the case of smaller sweep ranges the frequency between multiples of 100 kc/s (no-lock-in) can no longer be set with sufficient accuracy by means of f_1. In this case: set f_1 (with lock-in) to the 100-kc/s spectrum frequency which is the next lower to the desired frequency marker and shift the mid-frequency of the sweep curve horizontally with f_2 until the frequency desired for the frequency marker is reached. Now have a horizontal level line intersect the measuring curve in the frequency marker point. The mid-frequency can then be shifted again, as the marking of the frequency is preserved by the intersection of the level line with the measuring curve, provided that the measuring curve is sufficiently steep in the frequency marker point. After all desired frequency points of the measuring curve have been determined in this way and when the mid-frequency is no longer shifted, set the two shiftable frequency marker lines to the frequency marker points. The level lines just used can then be reused to establish a level scale.

2. Setting the Marker Width

Set the width of the frequency marker as outlined in D.2. with the OPTIMUM IN SWEEP RANGE double control knob in the corresponding position.

. Frequency Markers in the Case of Small Sweep Ranges of ±500 c/s to ±50 kc/s

. Setting the Frequency

The frequency results likewise from the sum of the readings $f_1 + f_2$ of the level oscillator. Make this setting only with the drive of the fine-setting control f_2, as f_1 is used to set the mid-frequency of the sweep signal.

. Setting the Marker Width

See E.2.

. Regulating Amplifier

The output voltage can be automatically stabilized with the aid of the Type Rel 3 B 939 probe and the regulating amplifier mounted in the sweep attachment. The transmitting level required in a particular case must be set on the level oscillator before the regulating voltage is connected (connection F-F, between the sweep attachment and the level oscillator). For this purpose operate the switch S3 (SWEEP RATE) to 0 and set a medium frequency with the control L1 (manual control). The transmitting level may be between +1 db and -10 db; the regulating factor is highest at zero transmitting level.

When a transmitting level below -10 db is required, interpose a variable attenuator between the specimen under test and the probe so that the input level to the specimen can be adjusted.

Set the internal impedance of the level oscillator (Z/Ω switch S3) to 0 Ω. (On the level oscillator, the black lettering applies to the level and impedance switches.) Establish a connection between jack F of the sweep attachment and jack F of the level oscillator.

Do not vary the transmitting level on the level oscillator after the regulating voltage has been connected because the regulating circuit will counteract any variation.

Set the same transmitting level as before the connection of the regulating voltage (see Fig.3) with the TRANSMITTING LEVEL double control knobs P4 (coarse) and P5 (fine) of the sweep attachment by reference to the instrument of the level oscillator.

Minor connections of the level (less than 1 db) can be carried out directly with the TRANSMITTING LEVEL P5 control in the regulating section of the sweep attachment without previously varying the transmitting voltage.

H. Lowest Test Frequency

The LOWEST TEST FREQUENCY control knob in the regulating amplifier (see Fig.3) has two positions: < 100 KC/S and > 100 KC/S. If the lowest frequency swept is below 100 kc/s, operate button T to < 100 KC/S, if it is above 100 kc/s, operate it to > 100 KC/S.

VORBEMERKUNG ZUR STÜCKLISTE

Die Stückliste zählt im wesentlichen die elektrischen Bauteile auf, und zwar nicht nur mit ihren Bestellangaben, sondern uach mit ihren Hauptkennwerten. Die Lage der Bauteile ist aus den entsprechenden Montageschaltplänen (ms) zu ersehen.

Unter Symbol stehen die in den Stromläufen verwendeten Abkürzungen für die Bauteile in alphabetischer und - soweit möglich - in numerischer Reihenfolge.

Mit Stück ist die Anzahl der gleichen Bauteile innerhalb der Geräte oder der Baugruppe bezeichnet.

In der Spalte Gegenstand sind außer dem Namen des Bauteiles auch seine Hauptkennwerte angegeben.

Mit der Bestellangabe ist das Bauteil durch einen Abkürzungs-Code oder eine Bauvorschrift eindeutig gekennzeichnet.

Es bedeuten:

bei einem Widerstand:	300 kΩ ± 5%; 0,5 W
300 kΩ	Nennwert des Widerstandes
± 5%	Toleranz des Nennwiderstandes
0,5 W	Belastbarkeit bezogen auf Umgebungstemperatur 20°C
bei einem Kondensator:	1000 pF ± 20%; 125 V-
1000 pF	Nennwert der Kapazität (1 pF = 1 µµF = 10^{-12} F)
± 20%	Toleranz der Nennkapazität
125 V-	zulässige Betriebsgleichspannung
bei einem Gleichrichter:	50V / 250mA
50 V	Anschluß-Wechselspannung
250 mA	entnehmbarer Betriebsstrom

+ Farb-Kurzzeichen:

bl = blau	rt = rot	rtgn = rot/grün
br = braun	rs = rosa	gesw = gelb/schwarz
ge = gelb	sw = schwarz	
gn = grün	ws = weiß	
gr = grau		

INTRODUCTORY REMARK TO THE PARTS LIST

The Parts List essentially enumerates the electrical component parts, specifying not only their ordering data, but also their principal parameters.
The positions of the component parts can be seen from the corresponding wiring diagrams (ms).

The SYMBOL column shows the abbreviations used for the components in the circuit diagrams in alphabetic and, to the extent possible, numerical order.

QTY denotes the number of identical components within the devices or the subassembly.

The DESCRIPTION column gives, besides the designation of the component, its principal characteristic data.

The ORDERING DATA column designates the component nonambiguously by an abbreviation code or component specification.

There denotes:

for a resistor: 300 kΩ ± 5%; 0,5 W

300 kΩ . . . . . Nominal value of the resistance
±5% . . . . . Tolerance of the nominal resistance
0,5 W . . . . . Wattage rating, as refered to an ambient temperature of 20°C

for a capacitor: 1000 pF ± 20%; 125V-

1000 pF . . . . . Nominal value of the capacitance (1 pF = 1 µµF = 10^{-12}f)
±20% . . . . . Tolerance of the nominal capacitance
125 V- . . . . . Permissible DC operating voltage

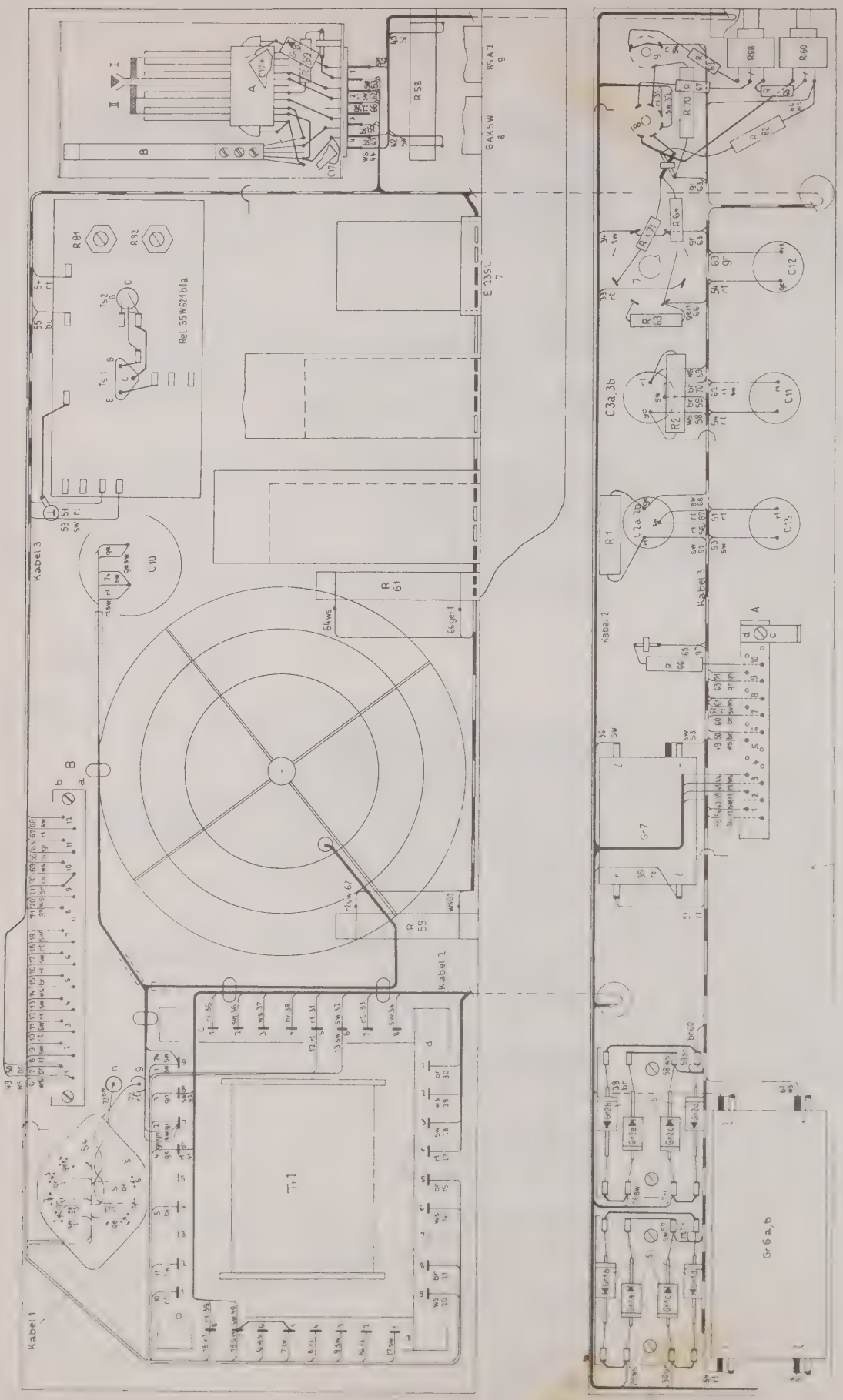
for a rectifier: 50V / 250mA

50 V . . . . . Primary AC voltage
250 mA . . . . . Available operating current

+ Color symbols

bl = blue	rt = red	rtgn = red/green
br = brown	sw = black	gesw = yellow/black
ge = yellow	ws = white	
gn = green	rs = pink	
gr = grey		

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA	Seite PAGE
		Netzteil POWER SUPPLY UNIT		
	1	I	Rel 35 W 546b1a	3
	1	II	Rel 35 W 544b1a	7
	1	Steuergerät CONTROL GENERATOR	Rel 35 W 545b1a	11
	1	Tiefpaß-Hochpaß LOW-PASS/HIGH-PASS FILTER	Rel 35 W 547b1a	14
	1	Frequenzmarken- und Regelverstärker FREQENCY MARKER AND REGULATING AMPLIFIER	Rel 35 W 548b1a	17
		Wobbel-Oszillator SWEEP OSCILLATOR		
	1	I	Rel 3 W 937b1a	22
	1	II	Rel 3 W 938b1a	31
P	1	Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR 500kΩ +20/-30%; 2W	500 K lin Rel wd 157b	
P 4/5	1	Schicht-Doppel-Drehwiderstand DOUBLE LAYER-TYPE VAR RESISTOR 40kΩ/10k/ 0,4W	40 K lin/10 K lin C42408-Z23-C5	
R 71	1	Schichtwiderstand LAYER-TYPE RESISTOR 250kΩ ±5%; 0,25W	B51263-A2254-J	
S 5	1	Drehschalter ROTARY SWITCH	Rel sch 302a Form N	
	1	Federleiste CLIP-CONTACT STRIP 20polig / 20-POLE	Rel ale 36b	
	1	Anschlußleiste CONNECTING CORD	Rel ltg 702e	
	1	Koax-Leitung COAXIAL CORD	Rel ltg 592a	
	1	Prüfkabel TEST CORD	Rel Bv 657 C 3004	

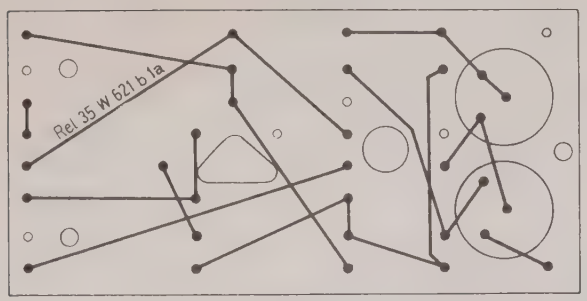


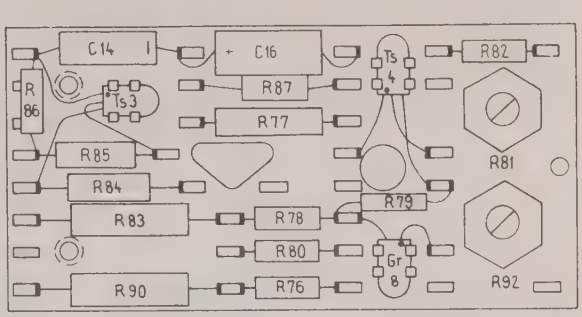
Netzteil I Rel ms 35 W 546b1a Ausg. III
POWER SUPPLY UNIT I Rel ms 35 W 546b1a ISSUE III

	1	Stabilisierungseinheit STABILIZER UNIT	Rel 35 W 621b1a
C 2a,b 3a,b	2	Doppel-Elektrolyt-Kond. DOUBLE ELECTROLYTIC CAP'R 32+32pF +50/-10%; 500V-	B43731-A6646-T
C 10	1	MP-Kondensator MP CAPACITOR 4µF ±10%; 400V-	B25040-A4405-K1
		Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR	
C 11	1	100µF +50/-10%; 350V-	B43691-A4107-T
C 12	1	100µF +50/-10%; 250V-	B43691-A2107-T
C 13	1	2500µF +50/-20%; 35V-	B41711-A7258-S
C 17	1	4µF +50/-10%; 250V-	B43711-A2405-T
Gr 1a-d 2a-d 10	9	Silizium-Kleingleichrichter MIDGET SILICON RECTIFIER	V23212-C0880
		Flachgleichrichter FLAT-TYPE RECTIFIER	
Gr 6a,b	2	300V / 200mA	Kc 1,3a 22/10-2,5
Gr 7	1	30V / 1000mA	Kc 2,7b 24/1
		Drahtwiderstand WIRE-WOUND RESISTOR	
R 1,2	2	200Ω ±5%; 2W	200 Ω 5% GWD 2 Fa.Rosenthal
R 58	1	1kΩ ±5%; 20W	1 K 5% GWS 20 Fa.Rosenthal
R 59	1	200Ω ±5%; 20W	200 Ω 5% GWS 20 Fa.Rosenthal
R 61	1	1kΩ ±5%; 35W	1 K 5% GWS 35 Fa.Rosenthal
R 62	1	200Ω ±5%; 4W	200 Ω 5% GWD 4 Fa.Rosenthal
R 66	1	2kΩ ±5%; 2W	2 K 5% GWD 2 Fa.Rosenthal
R 89	1	25Ω ±5%; 2W	25 Ω 5% GWD 2 Fa.Rosenthal
R 63	1	Schichtwiderstand LAYER-TYPE RESISTOR 100Ω ±5%; 0,5W	B 51265 A 100 Ω 5/2

		Schichtwiderstand LAYER-TYPE RESISTOR	
R 64	1	100kΩ ±5%; 0,33W	B 51264 A 100 K 5/2
R 65	1	25kΩ ±5%; 0,33W	B 51264 A 25 K 5/2
R 67,71	2	1kΩ ±5%; 0,25W	B51263-A2102-J
R 69	1	30kΩ ±5%; 0,33W	B 51264 A 30 K 5/2
R 70	1	15kΩ ±5%; 0,5W	B 51265 A 15 K 5/2
		Keramik-Potentiometer CERAMIC POTENTIOMETER	
R 60	1	10kΩ 2W	C44408-Z2-X3-0-27
R 68	1	5kΩ 2W	C44408-Z2-X3-0-27
RsB	1	Thermokontakt THERMAL RELAY	Fg kfs 30a Fg Bv 52/101a
S 2	1	Spannungswählschalter VOLTAGE ADJUSTER	Rel sch 268a
Tr 1	1	Netztransformator POWER TRANSFORMER	Rel Bv 621 L 3100
		Transistor TRANSISTOR	
Ts 1	1		AUY 24
Ts 2	1		ADY 12
		Lötstiftleiste SOLDERING-PIN STRIP	
	1	24polig / 24-POLE	Rel ale 56aq
	1	21polig / 21-POLE	Rel ale 23an
	1	8polig / 8-POLE	9Rel ale 23ad
RsA	1	Keilrelais AC/DC RELAX 10000 Wdg 1550Ω ±10%	T rls 152a T Bv 63017/63n

Stabilisierungseinheit 12,6V Rel 35 W 621b1a (Ausgabe II)
STABILIZER UNIT, 12.6 V (ISSUE II)

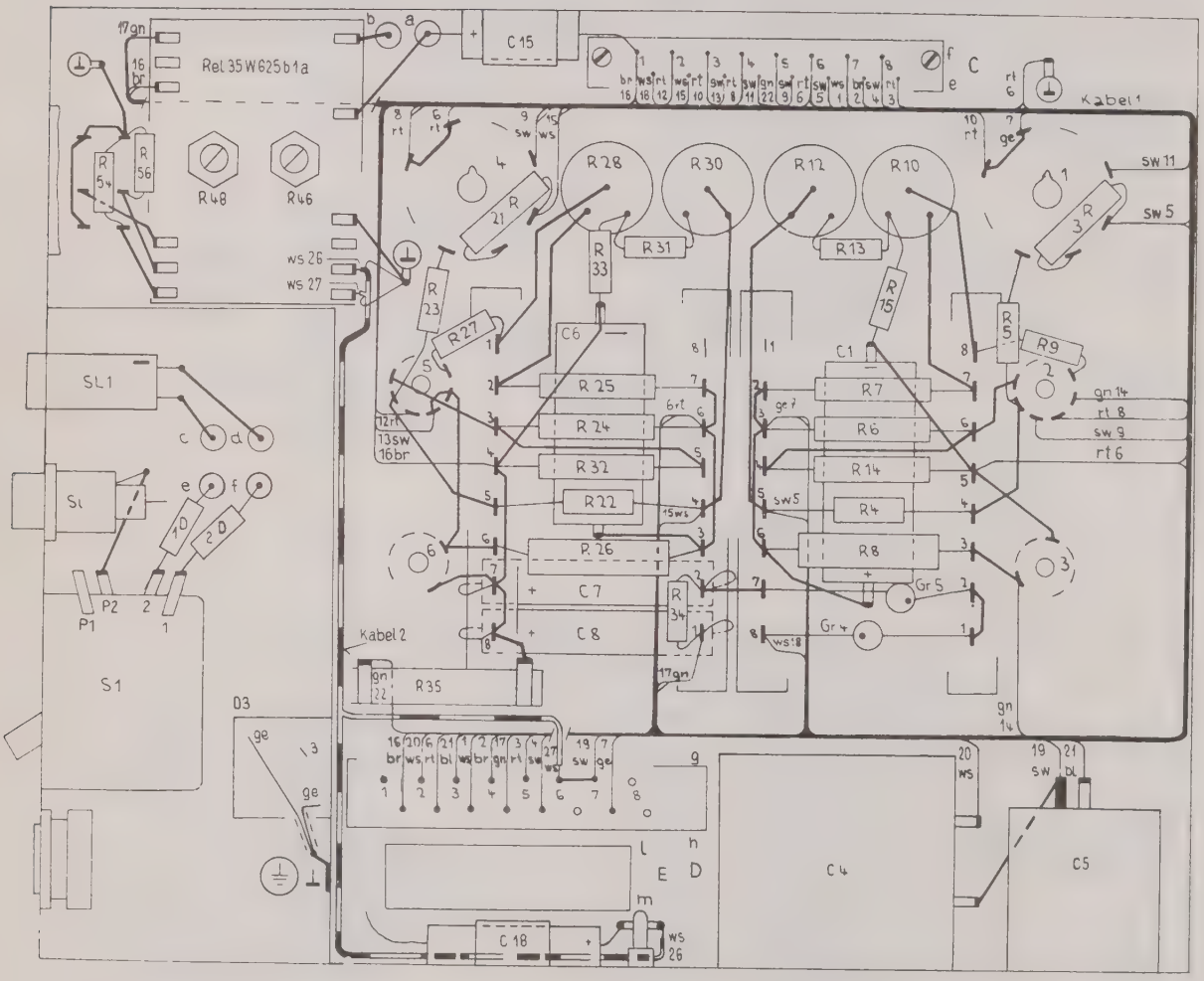




Stabilisierungseinheit 12,6 V Rel ms 35 W 621b1 Ausg. I
STABILIZER UNIT 12,6 V Rel ms 35 W 621b1 ISSUE I

C 14	1	MKL-Kondensator MKL CAPACITOR 0,33µF ±20%; 50V-	B32110-C9334-M
C 16	1	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 10µF +50/-20%; 35V-	B41951-A7106-S
Gr 8	1	Silizium-Diode SILICON DIODE	SZ 7 KB
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 76	1	3kΩ ±5%; 0,25W	B 51263 A 3 K 5/2
R 78	1	800Ω ±5%; 0,25W	B51263 A 800 Ω 5/2
R 79	1	50Ω ±5%; 0,25W	B 51263 A 50 Ω 5/2
R 80,82	2	500Ω ±5%; 0,25W	B 51263 A 500 Ω 5/2
R 84	1	16Ω ±5%; 0,33W	B 51264 A 16 Ω 5/2
R 85	1	2kΩ ±5%; 0,33W	B 51264 A 2 K 5/2
R 86	1	1kΩ ±5%; 0,25W	B 51263 A 1 K 5/2
R 87	1	70Ω ±5%; 0,25W	B 51263 A 70 Ω 5/2
		Drahtwiderstand WIRE-WOUND RESISTOR	
R 77	1	1Ω ±5%; 2W	1 Ω 5% ZWD 2 Klasse 1 Fa.Rosenthal
R 83	1	100Ω ±5%; 2W	100 Ω 5% GWD 2 Fa.Rosenthal
R 90	1	40Ω ±5%; 2W	40 Ω 5% GWD 2 Fa.Rosenthal

		Keramik-Potentiometer CERAMIC POTENTIOMETER	
R 81	1	500 Ω 2W	500 Ω lin
R 92	1	10kΩ 2W	10 kΩ lin
Ts 3,4	2	Transistor TRANSISTOR	ACY 14



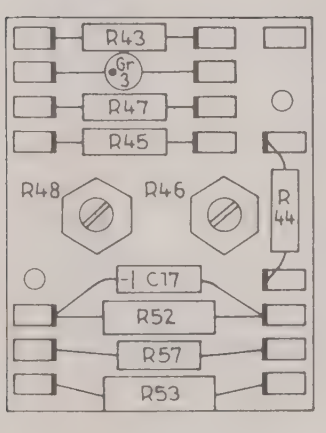
Netzteil II Rel ms 35 W 544b1a Ausg. II
POWER SUPPLY UNIT II Rel ms 35 W 544b1a ISSUE II

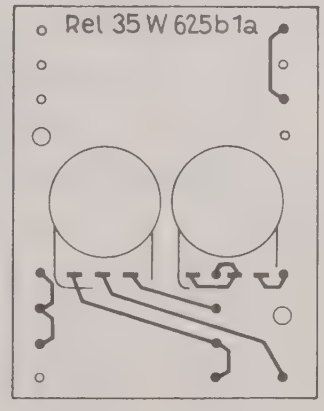
	1	Bauteileplatte COMPONENT BOARD	Rel 35 W 625b1a 9
		Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR	
C 1,6	2	8µF +30/-10%; 350V-	B43651-B4805-Q
C 7,8	2	8µF +50/-10%; 250V-	B43651-B2805-T
C 15	1	50µF +50/-20%; 35V-	B41931-A7506-S
C 18	1	2µF +50/-10%; 350V-	B43711-A4202-T
		MP-Kondensator MP CAPACITOR	
C 4	1	4µF ±10%; 630V-	B25224-A6405-K
C 5	1	1µF ±10%; 630V-	B25214-A6105-K
D 1,2	2	UKW-Drossel VHF CHOKE 45µH / 1,5A	B82501-C-C12
D 3	1	Drossel CHOKE	Rel Bv 622 N 3385
Gr 4,5	2	Silizium-Diode SILICON DIODE	BAY 30
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 3,21	2	100Ω ±10%; 0,75W	B 51265 A 100 Ω 10/5
R 4,22	2	100kΩ ±5%; 0,33W	B 51264 A 100 K 5/2
R 5,23	2	1kΩ ±5%; 0,33W	B 51264 A 1 K 5/2
R 6,24	2	30kΩ ±5%; 0,5W	B 51265 A 30 K 5/2
R 7,14 25,32	4	100kΩ ±5%; 0,5W	B 51265 A 100 K 5/2
R 8,26	2	40kΩ ±5%; 1W	B 51266 A 40 K 5/2
R 9,27	2	1kΩ ±5%; 0,25W	B51263-A2102-J
R 13,31	2	1MΩ ±5%; 0,33W	B 51264 A 1 M 5/2
R 15,33	2	30kΩ ±5%; 0,33W	B 51264 A 30 K 5/2
R 34	1	8kΩ ±5%; 0,33W	B 51264 A 8 K 5/2
R 54	1	5kΩ ±5%; 0,25W	B51263-A2502-J
R 56	1	15kΩ ±5%; 0,25W	B51263-A2153-J
R 35	1	Drahtwiderstand WIRE-WOUND RESISTOR 12,5kΩ ±5%; 15W	GWS 15 12,5 kΩ ±5% Fa.Rosenthal

		Keramik-Potentiometer CERAMIC POTENTIOMETER	
R 10,28	2		10 K lin
R 12,30	2		500 K lin
S 1	1	Netzschalter POWER SWITCH	Rel sch 171a
SL	1	Signallampe INDICATING LAMP 6V / 100mA	Fg lp 62bc
		Lötstiftleiste SOLDERING-PIN STRIP	
	1		9 Rel ale 23bi
	1		9 Rel ale 56bi
	4	Lötösenleiste SOLDERING-LUG STRIP	9 Rel ale 11bk

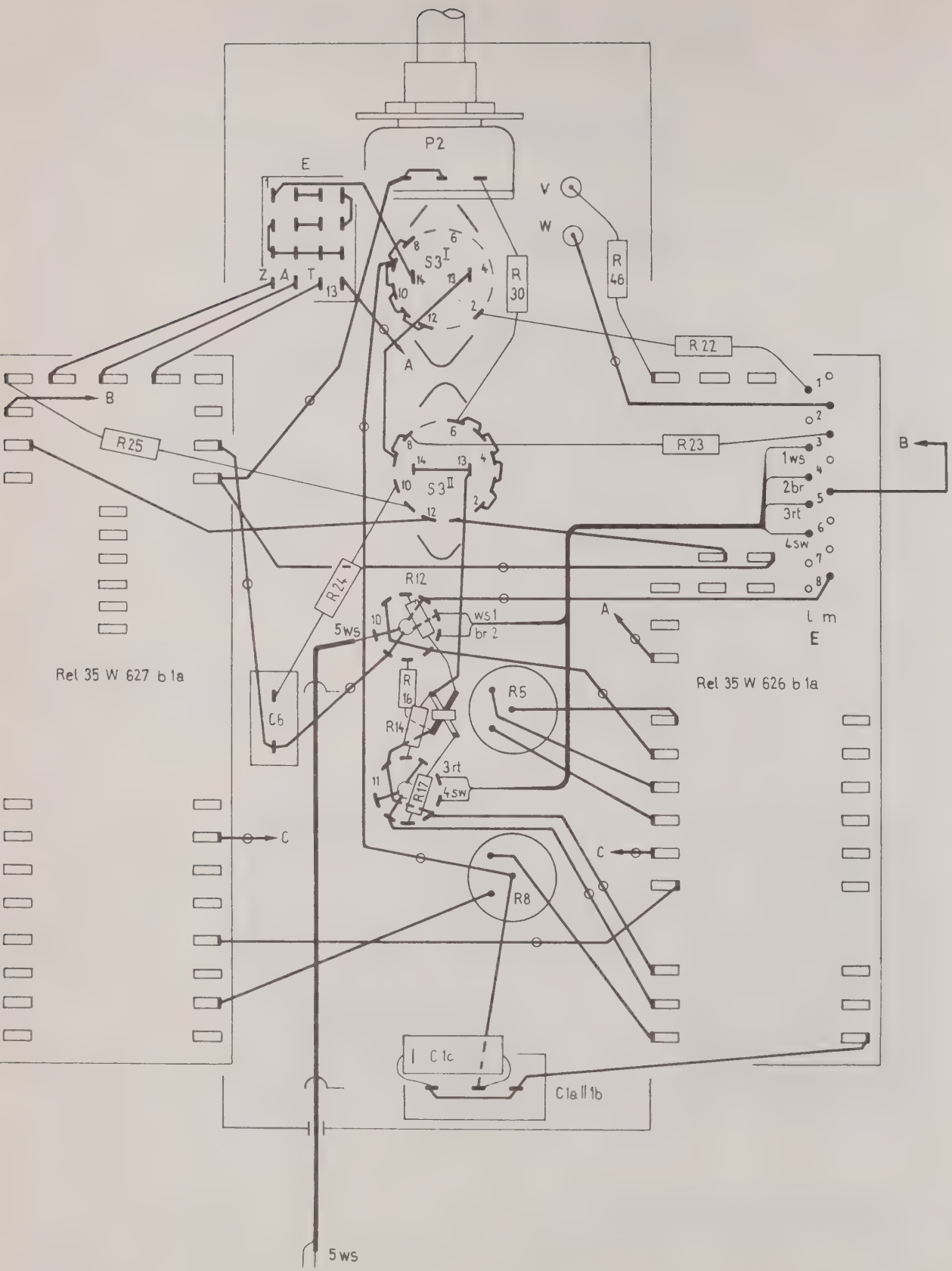
Bauteileplatte Rel 35 W 625b1a (Ausgabe II)
COMPONENT BOARD (ISSUE II)

C 17	1	Keramik-Kondensator CERAMIC CAPACITOR 15pF ±10%	B 38223 N075 C 15 K
Gr 3	1	Silizium-Diode SILICON DIODE	SZ 20 KB
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 43	1	100kΩ ±5%; 0,25W	B51263-A2104-J
R 44	1	160kΩ ±5%; 0,25W	B51263-A2164-J
R 45	1	8kΩ ±5%; 0,25W	B51263-A2802-J
R 47	1	150kΩ ±5%; 0,25W	B51263-A2154-J
R 52	1	800kΩ ±5%; 0,33W	B 51264 A 800 K 5/2
R 53	1	200kΩ ±5%; 0,33W	B 51264 A 200 K 5/2
R 57	1	50kΩ ±5%; 0,25W	B51263-A2503-J
		Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR	
R 46	1	5kΩ 0,1W	5 kΩ lin Rel wd 165a
R 48	1	50kΩ 0,1W	50 kΩ lin Rel wd 165a





Bauteileplatte Rel ms 35 W 625b1a Ausg. I
COMPONENT BOARD Rel ms 35 W 625b1a ISSUE I

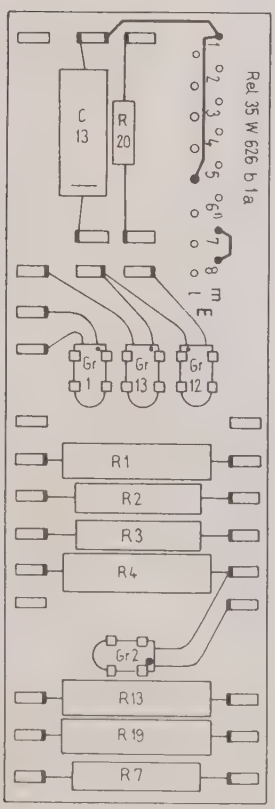


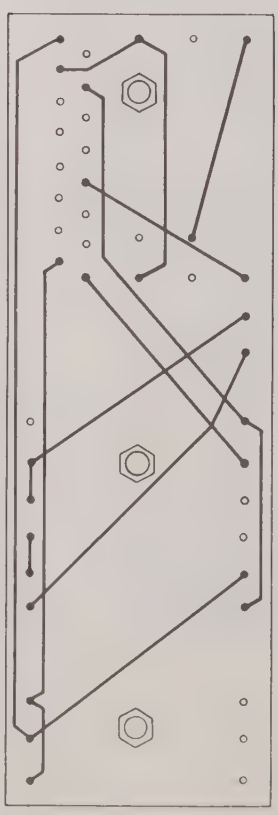
Steuergenerator Rel ms 35 W 545b1a Ausg. II
CONTROL GENERATOR Rel ms 35 W 545b1a ISSUE II

	Bauteileplatte COMPONENT BOARD		
1		Rel 35 W 626b1a	12
1		Rel 35 W 627b1a	13
	MP-Kondensator MP CAPACITOR		
C 1a,b	1	2x0,5µF ±20%; 250V-	B25174-A2105-M
C 6	1	0,25µF ±20%; 630V-	B25216-J6254-M
C 1c	1	MKL-Kondensator MKL capacitor 0,22µF ±20%; 250V-	B32110-C2224-M
P 2	1	Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR	C44408-Z2-X1-0-27 1 MΩ lin
R 5,8	2	Keramik-Potentiometer CERAMIC POTENTIOMETER 10kΩ 2W	C44408-Z2-X3-0-27 10 kΩ lin
	Schichtwiderstand LAYER-TYPE RESISTOR		
R 12,14 16,17	4	1kΩ ±5%; 0,25W	B51263-A2102-J
R 22-25	4	100kΩ ±5%; 0,25W	B51263-A2101-J
R 30,46	2	200kΩ ±5%; 0,25W	B51263-A2204-J
S 3	1	Kleindrehschalter MIDGET ROTARY SWITCH	Rel sch 302b Form B
RsE	1	T-Relais T RELAY	T rls 67af T Bv 3402/1 (W/Jr)

Bauteileplatte Rel 35 W 626b1a (Ausgabe II)
COMPONENT BOARD (ISSUE II)

C 13	1	MKH-Kondensator MKH CAPACITOR 0,1µF ±20%; 600V-	B32220-A0104-M
Gr 1,2	2	Silizium-Diode SILICON DIODE	BAY 30
Gr 12,13	2	Silizium-Zenerdiode SILICON ZENER DIODE	SZ 6 KB
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 1,4	2	40kΩ ±5%; 1W	B 51266 A 40 K 5/2
R 2,3	2	25kΩ ±5%; 0,5W	B 51265 A 25 K 5/2
R 7	1	5kΩ ±5%; 0,5W	B 51265 A 5 K 5/2
R 13	1	1kΩ ±5%; 1W	B 51266 A 1 K 5/2
R 19	1	900Ω ±5%; 1W	B 51266 A 900 Ω 5/2
R 20	1	150kΩ ±5%; 0,25W	B51263-A2154-J

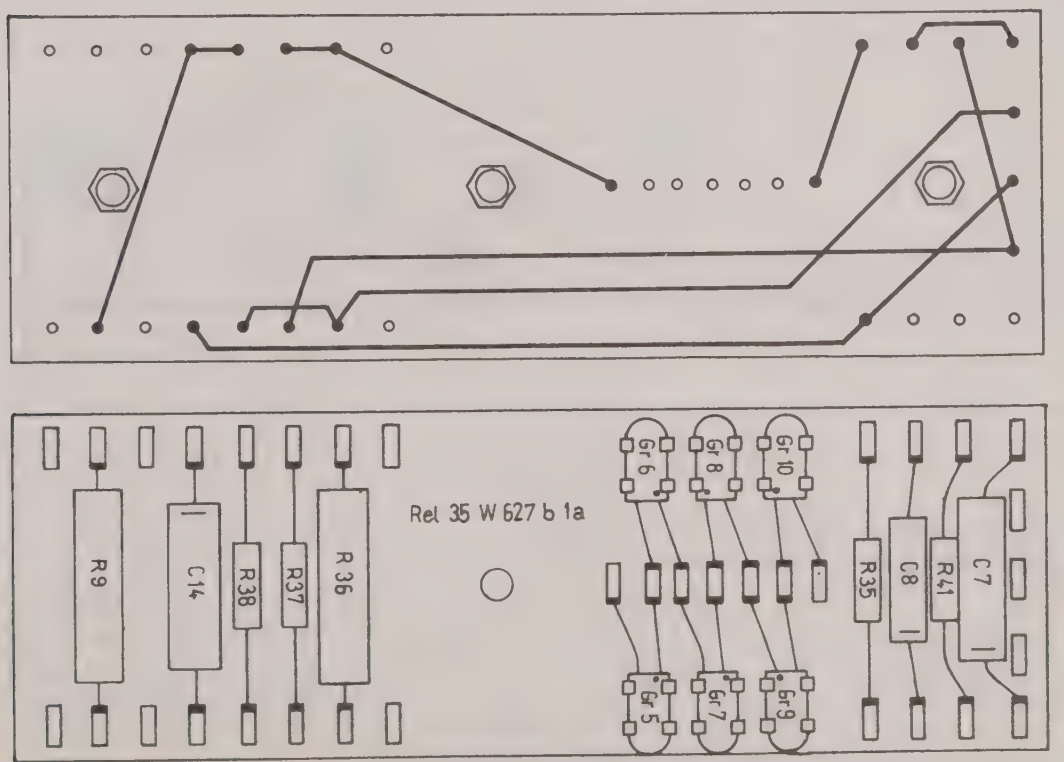




Bauteilplatte Rel ms 35 W 626b1a Ausg. II
COMPONENT BOARD Rel ms 35 W 626b1a ISSUE II

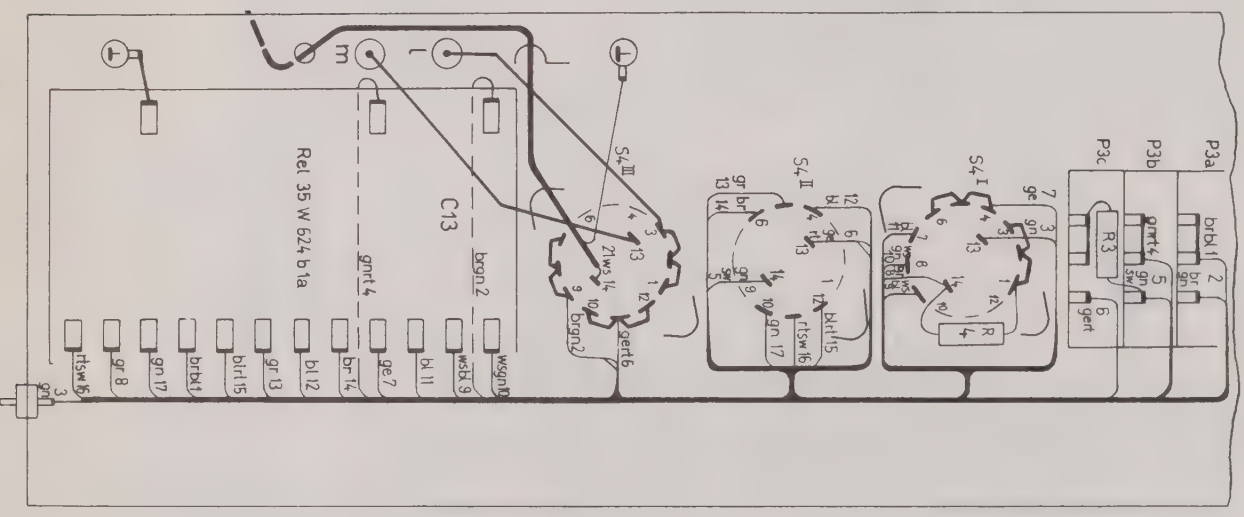
Bauteileplatte Rel 35 W 627b1a (Ausgabe I)
COMPONENT BOARD (ISSUE I)

		MKH-Kondensator MKH CAPACITOR	
C 7,14	2	0,047µF ±20%; 600V-	B32220-A6473-M
C 8	1	0,01µF ±20%; 600V-	B32220-A6103-M
Gr 5-10	6	Silizium-Zenerdiode SILICON ZENER DIODE	SZ 17 KB
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 9	1	20kΩ ±5%; 1W	B 51266 A 20 K 5/2
R 35	1	40kΩ ±5%; 0,25W	B51263-A2403-J
R 36	1	25kΩ ±5%; 1W	B 51266 A 25 K 5/2
R 37	1	100kΩ ±5%; 0,25W	B51263-A2104-J
R 38	1	60kΩ ±5%; 0,25W	B51263-A2603-J
R 41	1	20kΩ ±5%; 0,25W	B51263-A2203-J



Bauteilplatte Rel ms 35 W 627b1a Ausg. I
COMPONENT BOARD Rel ms 35 W 627b1a ISSUE I

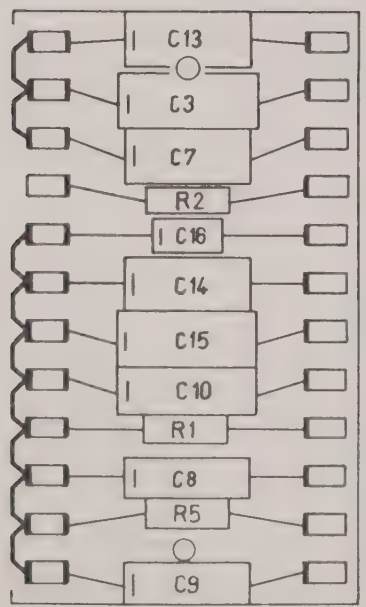
		Tiefpaß / Hochpaß Rel 35 W 547b1a LOW-PASS / HIGH-PASS FILTER		(Ausgabe III) (ISSUE III)	
	1	Bauteileplatte COMPONENT BOARD		Rel 35 W 624b1a	15
P 3 a,b,c	1	3-Fach-Potentiometer TRIPLE-GANGED POTENTIOMETER 5;5;25kΩ		C44408-Z2-X2-0-27	
		Schichtwiderstand LAYER-TYPE RESISTOR			
R 3	1	2,5kΩ ±5%; 0,25W		B51263-A2252-J	
R 4	1	800Ω ±5%; 0,25W		B51263-A2801-J	
S 4	1	Drehschalter ROTARY SWITCH		Rel sch 302c, Form B	



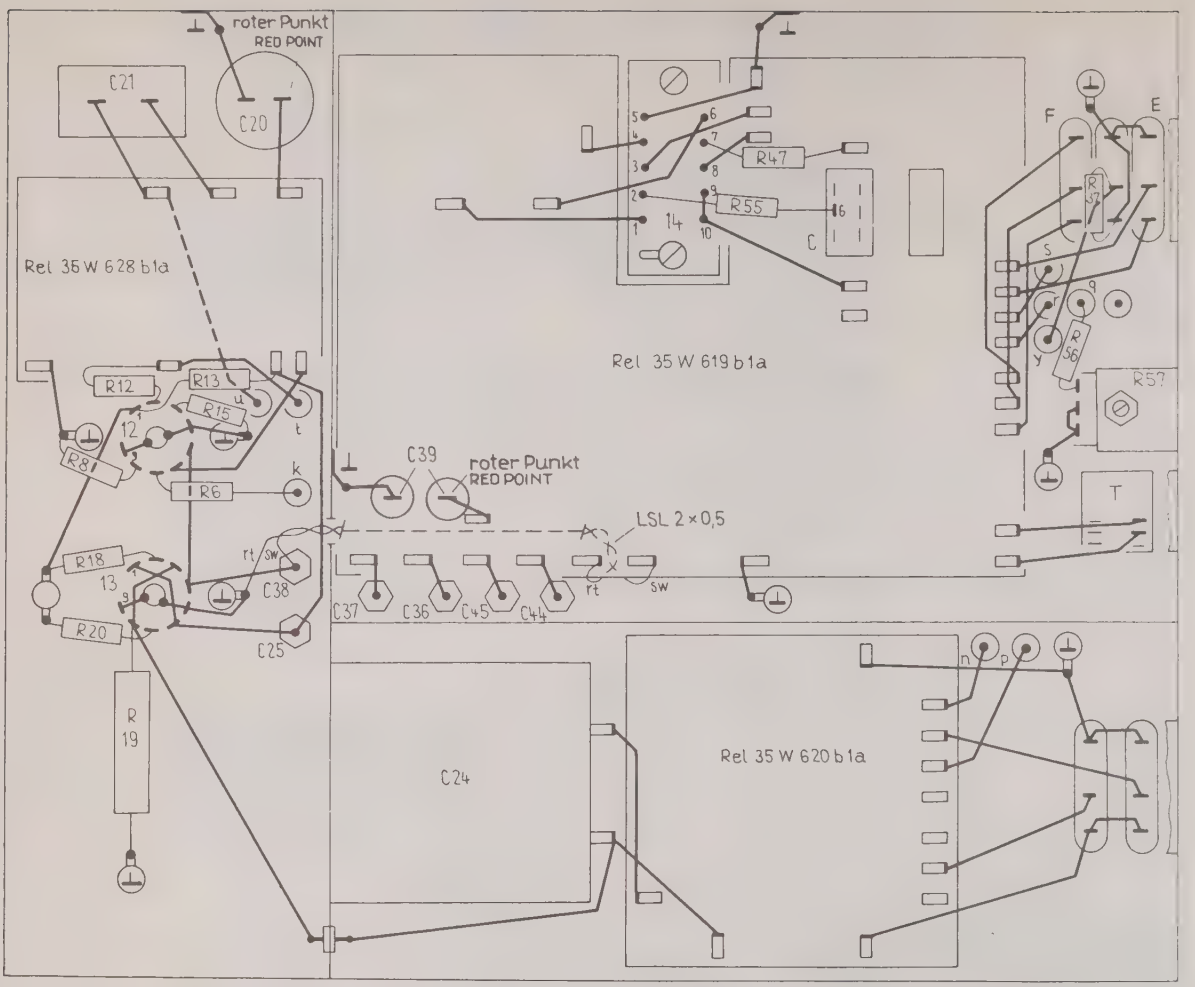
Tiefpaß/Hochpass Rel ms 35 W 547b1a Ausg. III
LOW PASS/HIGH-PASS FILTER Rel ms 35 W 547b1a ISSUE III

Bauteileplatte Rel 35 W 624b1a (Ausgabe II)
COMPONENT BOARD (ISSUE II)

		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 3,15	2	5000pF ±5%; 125V-	B31142-A1502-J
C 10	1	2500pF ±5%; 125V-	B31142-A1252-J
C 16	1	500pF ±5%; 125V-	B31140-A1501-J
		MKL-Kondensator MKL CAPACITOR	
C 7	1	0,47µF ±20%; 50V-	B32110-C9474-M
C 8	1	0,22µF ±20%; 50V-	B32110-C9224-M
C 9	1	0,022µF ±20%; 300V-	B32220-A3223-M
C 13,14	2	0,047µF ±20%; 300V-	B32220-A3473-M
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 1	1	100Ω ±5%; 0,25W	B51263-A2101-J
R 2	1	500Ω ±5%; 0,25W	B51263-A2501-J
R 5	1	200Ω ±5%; 0,25W	B51263-A2201-J

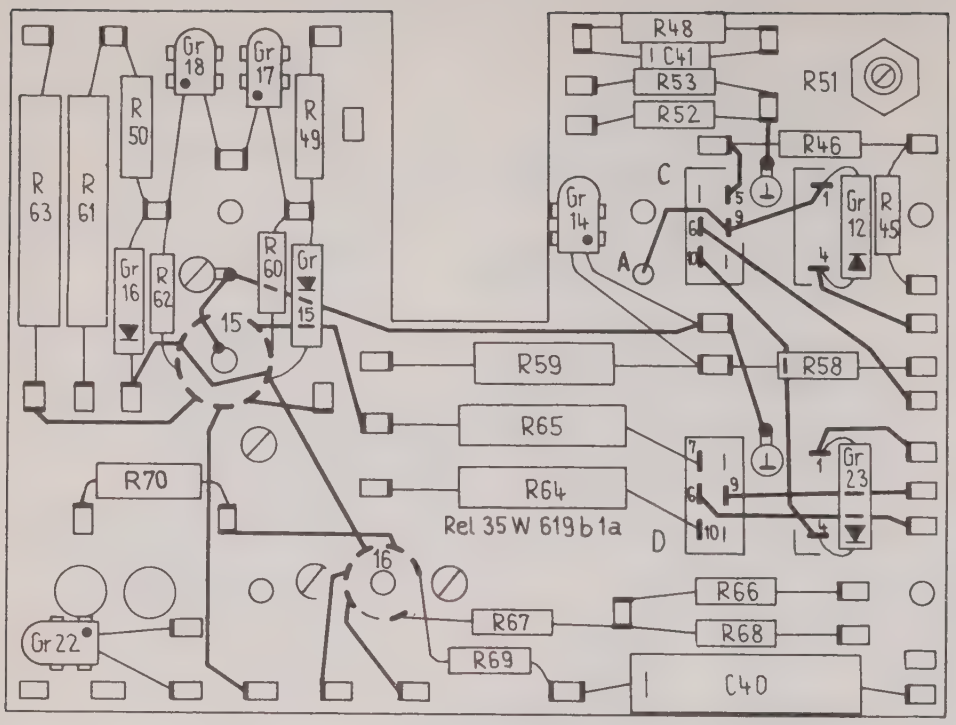


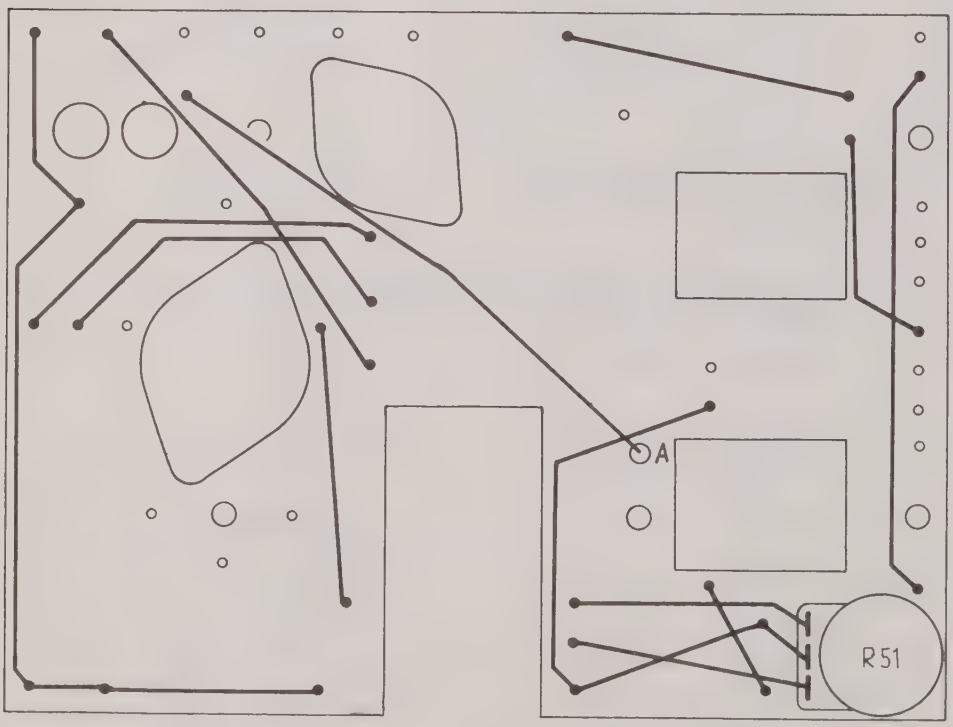
Bauteilplatte Rel ms 35 W 624b1a Ausg. II
COMPONENT BOARD Rel ms 35 W 624b1a ISSUE II



Frequenzmarken- und Regelverstärker Rel ms 35 W 548b1a Ausg. II
FREQUENCY MARKER AND REGULATING AMPLIFIER Rel ms 35 W 548b1a ISSUE II

	1	Regelverstärker REGULATING AMPLIFIER	Rel 35 W 619b1a	19
	1	Bauteileplatte COMPONENT BOARD	Rel 35 W 628b1a	20
	1	Frequenzmarken-Ausgang FREQUENCY MARKER OUTPUT	Rel 35 W 620b1a	21
		Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR		
C 20	1	50µF +50/-10%; 250V-	B43691-A2506-T	
C 39	1	500µF +50/-20%; 35V-	B41711-A7507-S	
		MP-Kondensator MP CAPACITOR		
C 21	1	2µF ±10%; 250V-	B25214-A2205-K	
C 24	1	8µF ±10%; 250V-	B25224-A2805-K	
		Durchführungskondensator LEAD-THROUGH CAPACITOR		
C 25,28	2	5000pF +30/-20%; 500V-	B37480-A5502-R000	
C 36,37 44,45	4	5000pF +30/-20%; 500V-	B37480-A5502-R001	
R 19	1	Drahtwiderstand WIRE-WOUND RESISTOR 2kΩ ±5%; 2W	GWD 2 2kΩ 5% Fa.Rosenthal	
		Schichtwiderstand LAYER-TYPE RESISTOR		
R 6 18,20	3	1kΩ ±5%; 0,25W	B 51263 A 1 K 5/2	
R 8	1	600Ω ±5%; 0,25W	B 51263 A 600 Ω 5/2	
R 12	1	100Ω ±5%; 0,25W	B 51263 A 100 Ω 5/2	
R 13	1	50kΩ ±5%; 0,33W	B 51264 A 50 K 5/2	
R 15	1	800Ω ±5%; 0,25W	B 51263 A 800 Ω 5/2	
R 37	1	5kΩ ±5%; 0,25W	B 51263 A 5 K 5/2	
R 47,55	2	300Ω ±5%; 0,25W	B 51263 A 300 Ω 5/2	
R 56	1	3,9kΩ ±5%; 0,25W	B 51263 A 3,9 K 5/2	
R 57	1	Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR	10 kΩ lin Rel wd 165a	
T	1	Drehschalter ROTARY SWITCH	Rel sch 197h Tz 16	



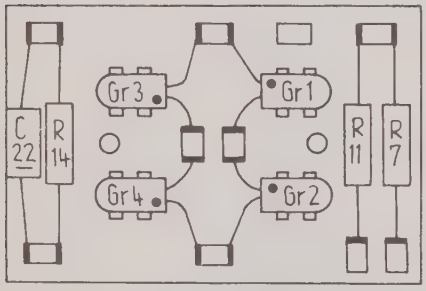


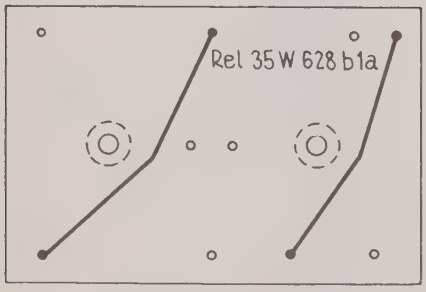
Regelverstärker Rel ms 35 W 619b1a Ausg. II
REGULATING AMPLIFIER Rel ms 35 W 619b1a ISSUE II

		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 40	1	20000pF ±10%; 125V-	B31143-A1203-K
C 41	1	300pF ±10%; 125V-	B31140-A1301-K
		Richtleiter CRYSTAL DIODE	
Gr 12,23	2		Kb 0,03 f 11/2
Gr 14	1		SZ 8 KB
Gr 15,16	2		GD 1 E
Gr 17,22	2		OA 5 (Fa.Valvo)
Gr 18	1		BAY 30
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 45	1	300kΩ ±5%; 0,25W	B 51263 A 300 K 5/2
R 46	1	300Ω ±5%; 0,25W	B 51263 A 300 Ω 5/2
R 48	1	2MΩ ±5%; 0,33W	B 51264 A 2 M 5/2
R 49,50	2	12kΩ ±5%; 0,5W	B 51265 A 12 K 5/2
R 52,53	2	30Ω ±5%; 0,25W	B 51263 A 30 Ω 5/2
R 58	1	60kΩ ±5%; 0,25W	B 51263 A 60 K 5/2
R 59	1	80kΩ ±5%; 2W	B 51266 A 80 K 5/2
R 60,62	2	10kΩ ±5%; 0,25W	B 51263 A 10 K 5/2
R 67	1	1kΩ ±5%; 0,25W	B 51263 A 1 K 5/2
R 69	1	40Ω ±5%; 0,25W	B 51263 A 40 Ω 5/2
R 70	1	20kΩ ±5%; 0,33W	B 51264 A 20 K 5/2
R 51	1	Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR 100Ω 0,1W	100 Ω lin Rel wd 165a
		Drahtwiderstand WIRE-WOUND RESISTOR	
R 61,63	2	2kΩ ±2%; 4W	GWD 4 2 kΩ ±2% Fa.Rosenthal
R 64,65	2	1,5kΩ ±5%; 4W	GWD 4 1,5 kΩ ±5% Fa.Rosenthal
R 66,68	2	Schichtwiderstand LAYER-TYPE RESISTOR 100kΩ ±5%; 0,25W	B 51263 A 100 K 5/2
RsD RsE	2	T-Relais T RELAIS	T Bv 65421/119d

Bauteileplatte Rel 35 W 628b1a (Ausgabe I)
COMPONENT BOARD (ISSUE I)

C 22	1	Kf-Kondensator PLASTIC-FOIL CAPACITOR 300pF ±10%; 500V-	B31140-A5301-K
Gr 1-4	4	Silizium-Diode SILICON DIODE	BAY 30
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 7	1	25kΩ ±5%; 0,33W	B 51264 A 25 K 5/2
R 11	1	6kΩ ±5%; 0,25W	B51263-A2602-J
R 14	1	20kΩ ±5%; 0,25W	B51263-A2203-J

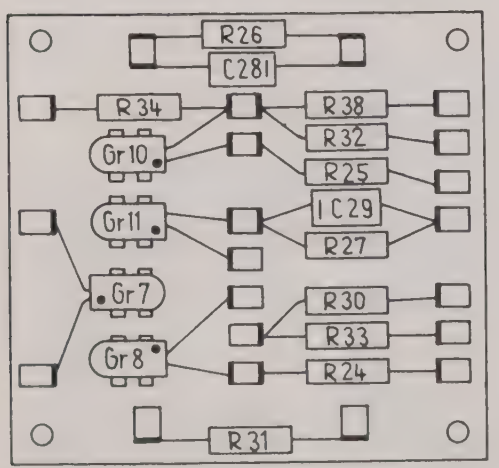


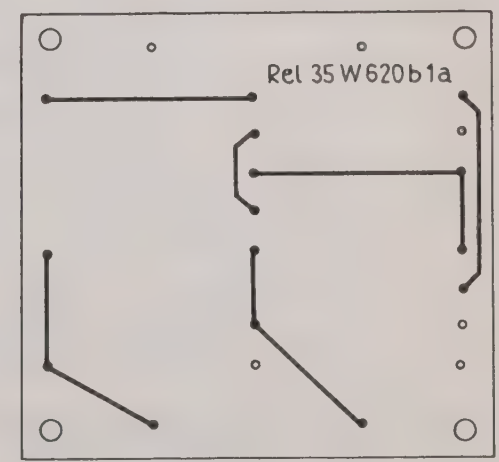


Bauteileplatte Rel ms 35 W 628b1a Ausg. II
COMPONENT BOARD Rel ms 35 W 628b1a ISSUE II

Frequenzmarken-Ausgang Rel 35 W 620b1a (Ausgabe II)
FREQUENCY MARKER OUTPUT (ISSUE II)

C 28,29	2	Kf-Kondensator PLASTIC-FOIL CAPACITOR 250pF ±5%; 500V-	B31140-A5251-J
		Richtleiter CRYSTAL DIODE	
Gr 7,8	2		OA 5 (Fa.Valvo)
Gr 10,11	2		SZ 20 KB
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 24	1	250kΩ ±5%; 0,25W	B 51263 A 250 K 5/2
R 25	1	12kΩ ±5%; 0,25W	B 51263 A 12 K 5/2
R 26,27	2	6kΩ ±5%; 0,25W	B 51263 A 6 K 5/2
R 30,34	2	1,5kΩ ±5%; 0,25W	B 51263 A 1,5 K 5/2
R 31-33	3	10kΩ ±5%; 0,25W	B 51263 A 10 K 5/2
R 38	1	50kΩ ±5%; 0,25W	B 51263 A 50 K 5/2





Frequenzmarken-Ausgang Rel ms 35 W 620b1a Ausg. I
FREQUENCY MARKER/OUTPUT Rel ms 35 W 620b1a ISSUE I

	Wobbeloszillator I Rel 3 W 937b1a SWEEP OSCILLATOR I		(Ausgabe I) (ISSUE I)	
	1	Leiterplatte Frequenzmarkenteil CONDUCTOR BOARD FREQUENCY-MARKER SECTION	Rel 35 W 611b1a	
	1	Hubentzerrer Hubentzerrer CONDUCTOR BOARD DEVIATION EQUALIZER	Rel 35 W 612b1a	27
	1	Tiefpaß 38 MHz 38-MC/S LOW-PASS FILTER	Rel 35 W 630b1a	28
	1	Satz Silmskalen SET OF FILM SCALES	Rel Bv 600 X 3014 oder Rel Bv 600 X 3013a	
		Keramik-Durchführungs-Kond. CERAMIC LEAD-THROUGH CAP'R		
C 1,51	2	100pF +30/-20%; 500V-	B37481-K5101-R000	
C 52,56-58	4	10000pF +30/-20%; 500V-	B37481-J5103-R000	
C 53-56,60 61	5	10000pF +30/-20%; 500V-	B37480-J5103-R000	
		Keramik-Kondensator CERAMIC CAPACITOR		
C 2	1	56pF ±5%; 500V-	B 38223 NPO E 56 J	
C 3	1	30pF ±2%; 500V-	B 38223 NPO D 30 G	
C 5	1	2200pF +30/-20%; 500V-	B37632-L2200-R	
C 6,12	2	3300pF +30/-20%; 500V-	B37232-L3300-R	
C 10,13	2	1000pF +30/-20%; 500V-	B 37638 L 1000 R	
C 14	1	15pF ±5%; 500V-	B 38223 N075 C 15 J	
C 17	1	47pF ±2%; 500V-	B 38223 N075 J 47 G	
C 4,11	2	Keramik-Bypaß CERAMIC BYPASS FILTER 2500pF +30/-20%; 350V-	B37470-A3252-R	
C 15,16	2	MKH-Kondensator MKH CAPACITOR 0,22µF ±20%; 300V-	B32220-A3223-M	
C 8	1	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 250pF +50/-0%; 70V-	B41712-B8257-Y	
Gr 8,9	2	Vario-Capacitor VARIABLE CAPACITOR	1 N 950 (Fa.Hughes)	

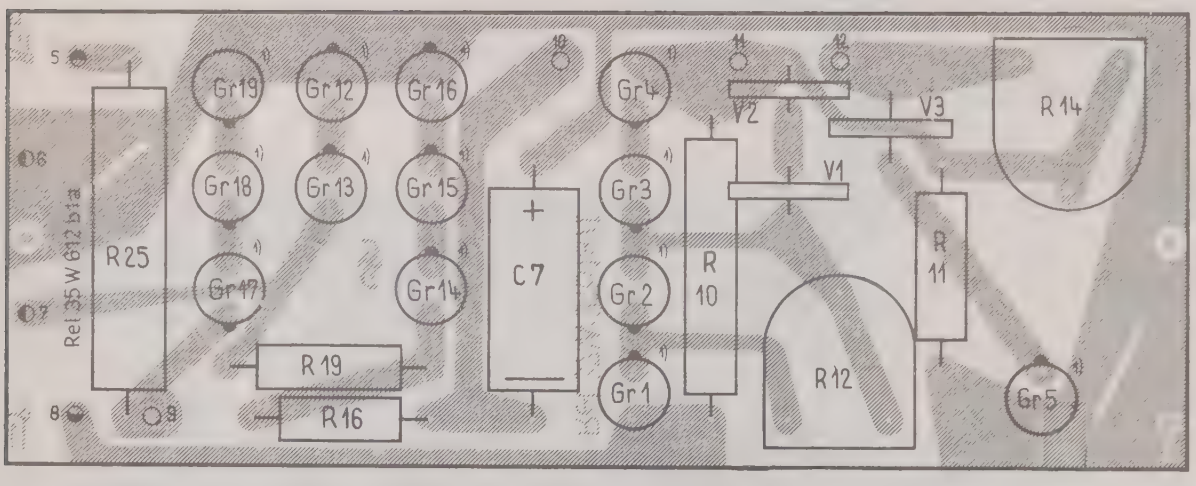
L 1	1	Variometer VARIOMETER	Rel Bv 624 A 3005
		Spule COIL	
L 2	1		Rel Bv 623 T 3024
L 3	1		Rel Bv 623 M 3044
L 4	1	UKW-Drossel VHF REACTOR 2µH / 2A	B82501-A-C2
L 5	1	Spule COIL	Rel Bv 623 B 3056
L 13	1	UKW-Drossel VHF REACTOR 40µH / 0,3A	B82501-A-A7
		Koaxial-Kabel COAXIAL CABLE	
Le 1	1		Rel Bv 657 A 3003a 104
Le 2	1		Rel Bv 657 A 3003a 105
Le 3	1		Rel Bv 657 A 193c 106
		Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR	
P 5	1	20kΩ 2W	20 K lin Rel wd 157b
P 6	1	20kΩ 2W	20 K lin Rel wd 157c
R 35	1	50kΩ 0,1W	50 K lin Rel wd 165a
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 2	1	80kΩ ±5%; 0,25W	B51263-A2803-J
R 3	1	1,8kΩ ±5%; 0,33W	B 51264 A 1,8 K 5/2
R 4	1	80kΩ ±2%; 1W	B 51266 A 80 K 2/2
R 5	1	10kΩ ±2%; 0,25W	B51263-A2103-G
R 6	1	1kΩ ±2%; 0,25W	B51263-A2102-G
R 7	1	5kΩ ±5%; 0,25W	B51263-A2502-J
R 13	1	50kΩ ±5%; 0,25W	B51263-A2503-J
R 15	1	7kΩ ±5%; 0,25W	B51263-A2702-J
R 17	1	650kΩ ±5%; 0,33W	B 51264 A 650 K 5/2
R 18,31	2	10kΩ ±5%; 0,25W	B51263-A2103-J
R 20	1	4,7kΩ ±5%; 0,25W	B51263-A2472-J
R 21	1	150Ω ±5%; 0,25W	B51263-A2151-J
R 22	1	40kΩ ±5%; 0,25W	B51263-A2403-J
R 23	1	100Ω ±5%; 0,25W	B51263-A2101-J
R 27	1	400Ω ±5%; 0,25W	B51263-A2401-J

		Schichtwiderstand LAYER-TYPE RESISTOR	
R 28	1	500Ω ±5%; 0,25W	B51263-A2501-J
R 29	1	100kΩ ±5%; 0,25W	B51263-A2104-J
R 30,32,48	3	50Ω ±5%; 0,25W	B51263-A2500-J
R 32	1	800Ω ±5%; 0,33W	B 51264 A 800 Ω 5/2
R 34	1	125kΩ ±5%; 0,25W	B51263-A2124-J500
R 36,40	2	25Ω ±5%; 0,25W	B51263-A2250-J
R 37,43	2	5kΩ ±5%; 1W	B 51266 A 5 K 5/2
R 39	1	300kΩ ±5%; 0,25W	B51263-A2304-J
R 41	1	20kΩ ±5%; 0,25W	B51263-A2203-J
R 44	1	30Ω ±5%; 0,25W	B51263-A2300-J
S 6	1	Drehschalter ROTARY SWITCH	Rel sch 175f Form B
SL	1	Signallampe INDICATING LAMP 60V / 100mA	Fg lp 62bc

Leiterplatte Frequenzmarkenteil Rel ms 35 W 611b1a Ausg. II
CONDUCTOR/BOARD FREQUENCY-MARKER SECTION Rel ms 35 W 611b1a ISSUE II

		Keramik-Kondensator CERAMIC CAPACITOR	
C 21	1	60pF ±5%	B 38223 N075 J 60 J
C 22,38,49	3	3,3pF ±0,25pF	B 38218 P100 A 3,3 C
C 23,25,26 28,29 32-35,39 42-45,48,50	16	4700pF +30/-20%	B 37632 L 4700 R
C 30	1	82pF ±1%	B 38223 N470 J 82 F
C 37,47	2	6800pF +30/-20%	B 37643 G 6800 R
C 40	1	100pF ±2%	B 38223 N470 E 100 G
C 27,36,46	3	MKH-Kondensator MKH CAPACITOR 0,1µF ±20%; 250V-	B32232-S3104-M
L 7,9,11	3	Spule COIL 2µH	Rel Bv 623 U 3021
L 12	1	Drossel CHOKE	Rel Bv 623 B 3053
L 14,15	2	UKW-Drossel VHF CHOKE 15µH / 2A	B82501-A-A24
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 46	1	100Ω ±5%; 0,25W	B 51263 A 100 Ω 5/2
R 47	1	10kΩ ±5%; 0,25W	B 51263 A 10 K 5/2
R 48,49,54 60,72,89 91	7	150Ω ±5%; 0,25W	B 51263 A 150 Ω 5/2
R 50,55,68 73,84,93	6	2,5kΩ ±5%; 0,33W	B 51264 A 2,5 K 5/2
R 51,74,94	3	500Ω ±5%; 0,25W	B 51263 A 500 Ω 5/2
R 52,71,88	3	30Ω ±5%; 0,25W	B 51263 A 30 Ω 5/2
R 53,70,90	3	120kΩ ±5%; 0,25W	B 51263 A 120 K 5/2
R 56,65,78	3	600Ω ±5%; 0,25W	B 51263 A 600 Ω 5/2
R 60-63 80-83	8	80Ω ±5%; 0,25W	B 51263 A 80 Ω 5/2
R 75,92	2	300Ω ±5%; 0,25W	B 51263 A 300 Ω 5/2
R 76,95	2	1,5kΩ ±5%; 0,25W	B 51263 A 1,5 K 5/2
R 77,96	2	150kΩ ±5%; 0,25W	B 51263 A 150 K 5/2
R 79	1	60Ω ±5%; 0,25W	B 51263 A 60 Ω 5/2

R 85	1	Schichtwiderstand LAYER-TYPE RESISTOR 125Ω ±5%; 0,25W	B 51263 A 125 Ω 5/2
Md 1,2	2	Modulator MODULATOR	Rel Bv 672 R 3
		Übertrager TRANSFORMER	
Ü 1	1		Rel Bv 622 N 3532
Ü 2	1		Rel Bv 622 N 3531
Ü 3	1		Rel Bv 622 N 3530
Ü 4	1		Rel Bv 622 N 3529



Strombahnen auf der Rückseite
CURRENT PATHS ON THE REAR

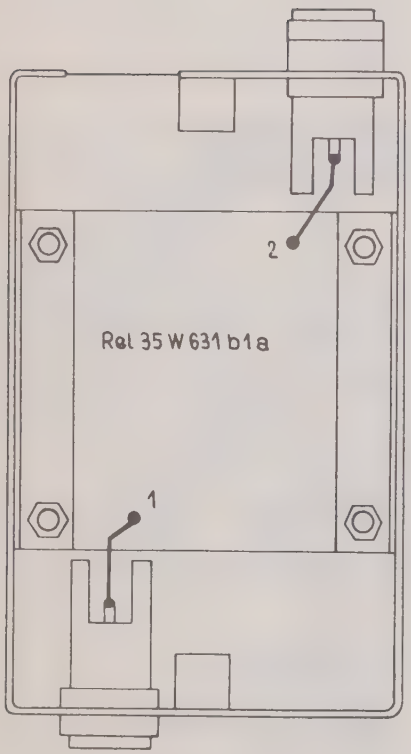
Leiterplatte Rel ms 35 W 612b1a Ausg. II
CONDUCTOR Rel ms 35 W 612b1a ISSUE II

Leiterplatte Rel 35 W 612b1a (Ausgabe III)
CONDUCTOR BOARD (ISSUE III)

C 7	1	Tantal-Elektrolyt-Kond. TANTALUM ELECTROLYTIC CAP'R 33µF ±20%; 35/40V-	B45146-A7336-M
Gr 1,5	2	Richtleiter CRYSTAL DIODE	BAY 30
		Zener-Diode ZENER DIODE	
Gr 2-4	3		SZ 16 KB
Gr 12,13	2		Rel Bv 672 R 168a 20
Gr 14,15	2		Rel Bv 672 R 108a 7
Gr 16	1		Rel Bv 672 R 168a 6
Gr 17-19	3		Rel Bv 672 R 168a 14
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 10	1	100kΩ ±5%; 0,5W	B 51265 A 100 K 5/2
R 11	1	25kΩ ±5%; 0,33W	B 51264 A 25 K 5/2
R 16	1	100kΩ ±5%; 0,25W	B 51263 A 100 K 5/2
R 19	1	1,6kΩ ±5%; 0,33W	B 51264 A 1,6 K 5/2
R 25	1	10kΩ ±5%; 1W	B 51266 A 10 K 5/2
		Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR	
R 12	1	100kΩ 1W	100 kΩ lin 59 Tr-K (DRALOWID)
R 14	1	50kΩ 1W	50 kΩ lin 59 Tr-K (DRALOWID)
V 1-3	3	Ocelit-Varistor OCELIT VARISTOR	125-100/4 Fa.Conradty

Tiefpaß 38 MHz Rel 35 W 630b1a (Ausgabe I)
38-MC/S LOW-PASS FILTER (ISSUE I)

1	Leiterplatte CONDUCTOR BOARD	Rel 35 W 631b1a	29



Tiefpaß 38 MHz Rel ms 35 W 630b1a Ausg. I
38-MC/S LOW-PASS FILTER Rel ms 35 W 630b1a ISSUE I

SIEMENS

Steuergenerator
CONTROL GENERATOR
Rel 35 W 545 b1a

El3 El4 El6 El5 Em5 El8 El1 Em3 Em7,8 El2 Em1 Em2,w v

P1

Dh3 Dg4 Dh5 Dg5 Dh4 Dh7 Dg2 Dg3 Dg6 Dg7 Dh2 Dh1 a b

C18

Netzteil II
POWER SUPPLY UNIT II
Rel 35 W 544 b1a

Cf7 Ce7 Cf8 Ce8 c d e f Ce4 Cf3 Ce5 Cf4 Ce3 Cf2 Cf6 Ce6 Ce1 Cf1 Ce2 Cf5

Ba5 Bb5 Bb6 Ba6 Ba1 Bb1 h g Bb3 Ba3 Bb4 Ba4 Bb2 Ba2 Ba12 Bb12 Ba9 Bb9 Bb10 Bb8

Tiefpaß-Hochpaß
LOW-PASS/
HIGH-PASS FILTER
Rel 35 W 547 b1a

S4 I l m S4 III l

S5 P4 P5

u t k y n p q r s

Frequenzmarken- und Regelverstärker
FREQUENCYMARKER - AND REGULATING AMPLIFIER
Rel 35 W 548 b1a

C45 C38 C36 C44 C37 C25

Ba7 Bb7 Ba10 Ba11 Bb11 Ac6 Ad5

Netzteil I
POWER SUPPLY UNIT I
Rel 35 W 546 b1a

Wobbeloszillator II
SWEEP OSCILLATOR II
Rel 3 W 938 b1a

Frequenzmarken
FREQUENCY MARKERS

Wobbelspannung
SWEEP VOLTAGE

Ka6 Ka1 Ka7 Ka0 Kb9 Ka8
Kb6 Kb1 Kb0 Ka9 Kb3 Kb8

Wobbeloszillator I
SWEEP OSCILLATOR I
Rel 3 W 937 b1a

Frequenzmarken
FREQUENCY MARKERS

Wobbelspannung
SWEEP VOLTAGE

Ka6 Ka1 Ka7 Ka0 Kb9 Ka3 Kb2 Ka8 Ka4 Ka5
Kb6 Kb1 Kb7 Kb0 Ka9 Kb3 Kb1 Kb8 Kb4

Ac1 Ad1 Ad2 Ac2 Ac9 Ac10 Ad9 Ac3 Ad3 Ac8 Ad7 Ac7

Wobbelzusatz
SWEEP ATTACHMENT

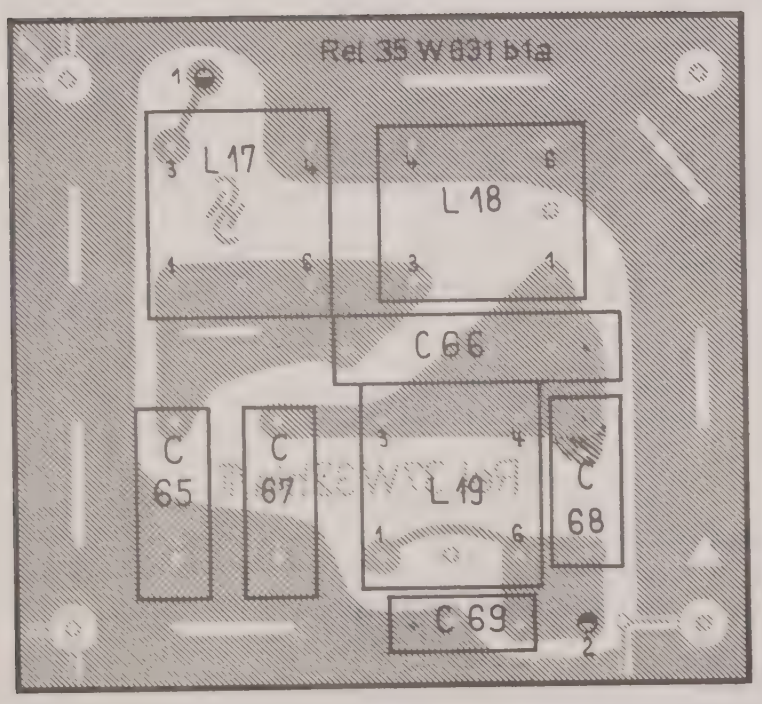
Rel str 3 W 933b 1a Dt/En

Ausg. II 23.8.65 Brehmer

Vervielfältigung dieser Unterlage sowie Verwertung und Mitteilung ihres Inhaltes unzulässig, soweit nicht ausdrücklich zugestanden. Zuwiderhandlungen sind strafbar und verpflichten zu Schadenersatz (LitUrhG, UWG, BGB). Alle Rechte für den Fall der Patenterteilung oder GM-Eintragung vorbehalten.
SIEMENS & HALSKE Aktiengesellschaft

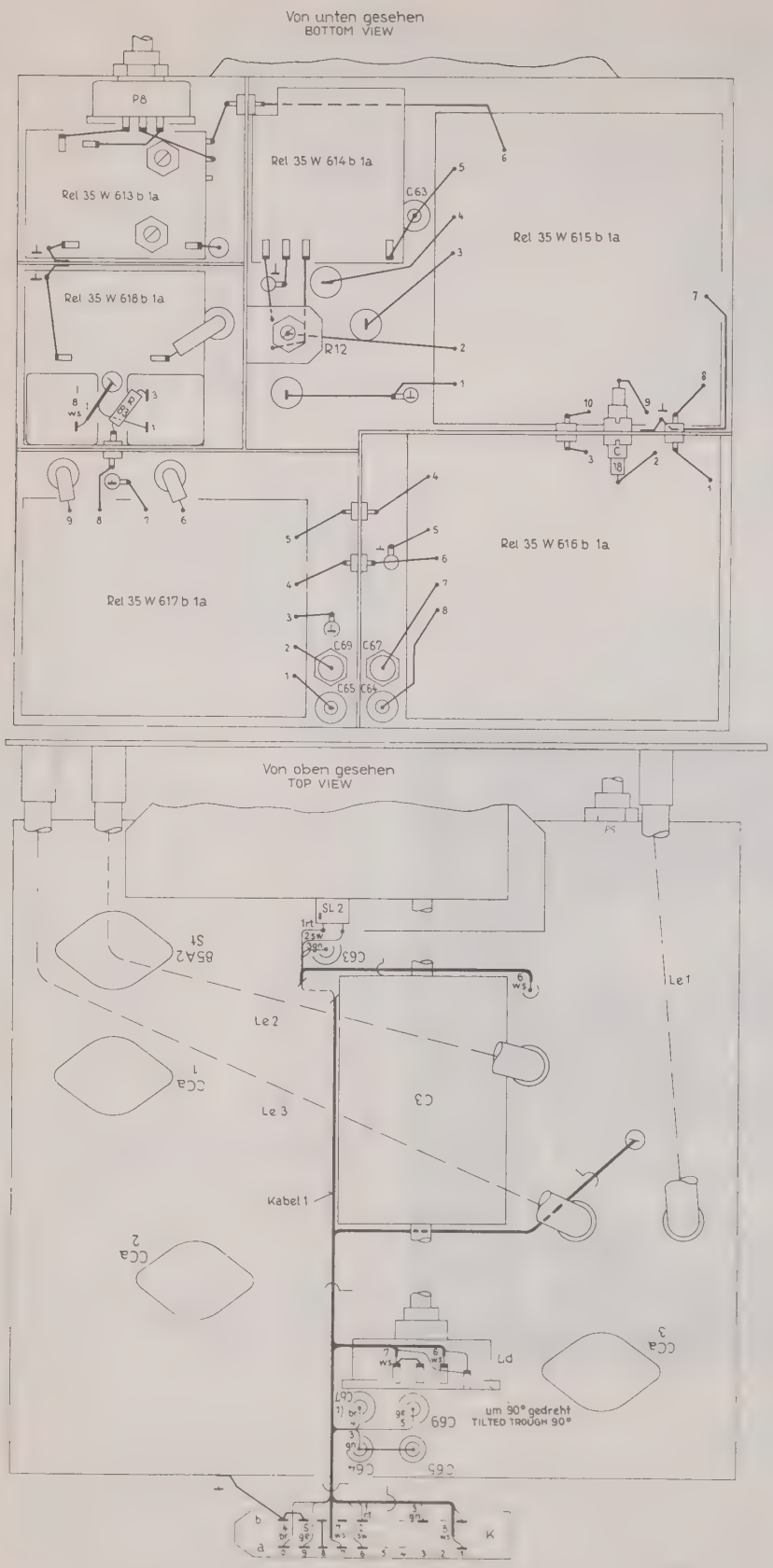
Leiterplatte Rel 35 W 631b1a (Ausgabe I)
CONDUCTOR BOARD (ISSUE I)

		Keramik-Kondensator CERAMIC CAPACITOR	
C 65	1	47,7pF ±1%	B 38223 N150 J 47,7 F
C 66	1	89,6pF ±1%	B 38223 N150 F 89,6 F
C 67	1	51,9pF ±1%	B 38223 N150 J 51,9 F
C 68	1	37,9pF ±1%	B 38223 N150 D 37,9 F
C 69	1	22pF ±0,25pF	B 38223 N150 C 22 F
		Spule COIL	
L 17	1		Rel Bv 623 U 3020
L 18	1		Rel Bv 623 U 3019
L 19	1		Rel Bv 623 U 3018



Strombahnen auf der Rückseite
CURRENT PATHS ON THE REAR

Leiterplatte Rel ms 35 W 631b1a Ausg. II
CONDUCTOR BOARD Rel ms 35 W 631b1a ISSUE II

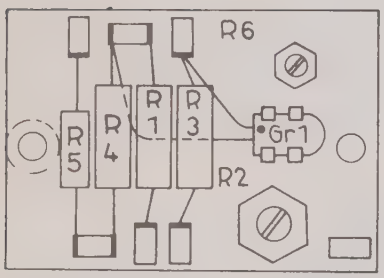


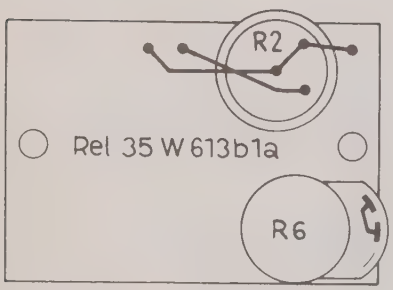
Wobbeloszillator II Rel ms 3 W 938b1a Ausg. II
SWEEP OSCILLATOR II Rel ms 3 W 938b1a ISSUE II

		Bauteileplatte COMPONENT BOARD		
	1		Rel 35 W 613b1a	32
	1		Rel 35 W 614b1a	33
		Leiterplatte CONDUCTOR BOARD		
	1	1	Rel 35 W 615b1a	35
	1	2	Rel 35 W 616b1a	37
	1	3	Rel 35 W 617b1a	39
	1	Modulationsstufe MODULATING STAGE	Rel 35 W 618b1a	40
C 3	1	Drehkondensator VARIABLE CAPACITOR 2x5,5/15,5pF	C42208-Z8-C231	
		Keramik-Durchführungs-Kond. CERAMIC LEAD-THROUGH CAP'R		
C 18	1	5000pF +30/-20%; 500V-	B37480-A5502-R000	
C 63-65	3	10000pF +30/-20%; 500V-	B37480-J5103-R001	
C 67,69	2	0,025µF; 160/110V	B 85121 DB 03	
		Koaxiale Verbindungsleitung COAXIAL CONNECTING CORD		
Le 1	1		Rel Bv 657 A 3003a 104	
Le 2	1		Rel Bv 657 A 3003a 102	
Le 3	1		Rel Bv 657 A 3003a 103	
		Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR		
P 7	1		50 kΩ lin Rel wd 157b	
P 8	1		10 kΩ log Rel wd 157c	
R 12	1	Keramik-Potentiometer CERAMIC POTENTIOMETER 5kΩ 2W	5 K lin C44408-Z2-X3-0-27	
R 83	1	Schichtwiderstand LAYER-TYPE RESISTOR 100Ω ±5%; 0,25W	B 51263 A 100 Ω 5/2	
SL 2	1	Signallampe INDICATING LAMP 6V / 100mA	Fg 1p 62bc	
	1	Satz Filmskalen SET OF FILM SCALES	Rel Bv 600 X 3014a oder Rel Bv 600 X 3013a	

Bauteileplatte Hubregler Rel 35 W 613b1a (Ausgabe II)
COMPONENT BOARD / DEVIATION CONTROL (ISSUE II)

Gr 1	1	Silizium-Diode SILICON DIODE	BAY 30
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 1	1	15kΩ ±5%; 0,33W	B 51264 A 15 K 5/2
R 3	1	3kΩ ±5%; 0,33W	B 51264 A 3 K 5/2
R 4	1	40kΩ ±5%; 0,33W	B 51264 A 40 K 5/2
R 5	1	200Ω ±5%; 0,25W	B 51263 A 200 Ω 5/2
R 2	1	Keramik-Potentiometer CERAMIC POTENTIOMETER	10 K lin C44408-Z2-X4-0-27
R 6	1	Schicht-Drehwiderstand LAYER-TYPE VAR RESISTOR	10 kΩ lin Rel wd 165a

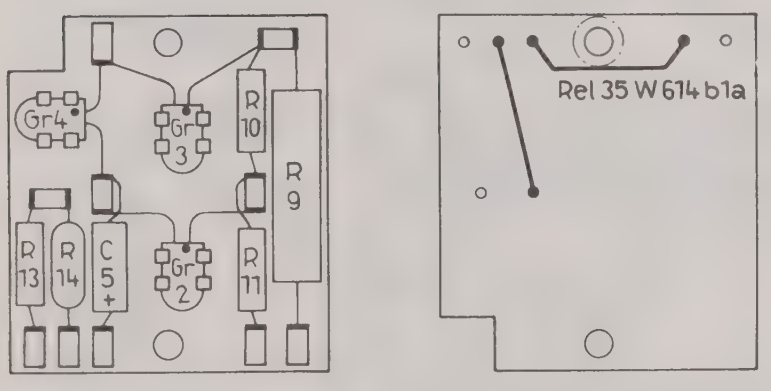




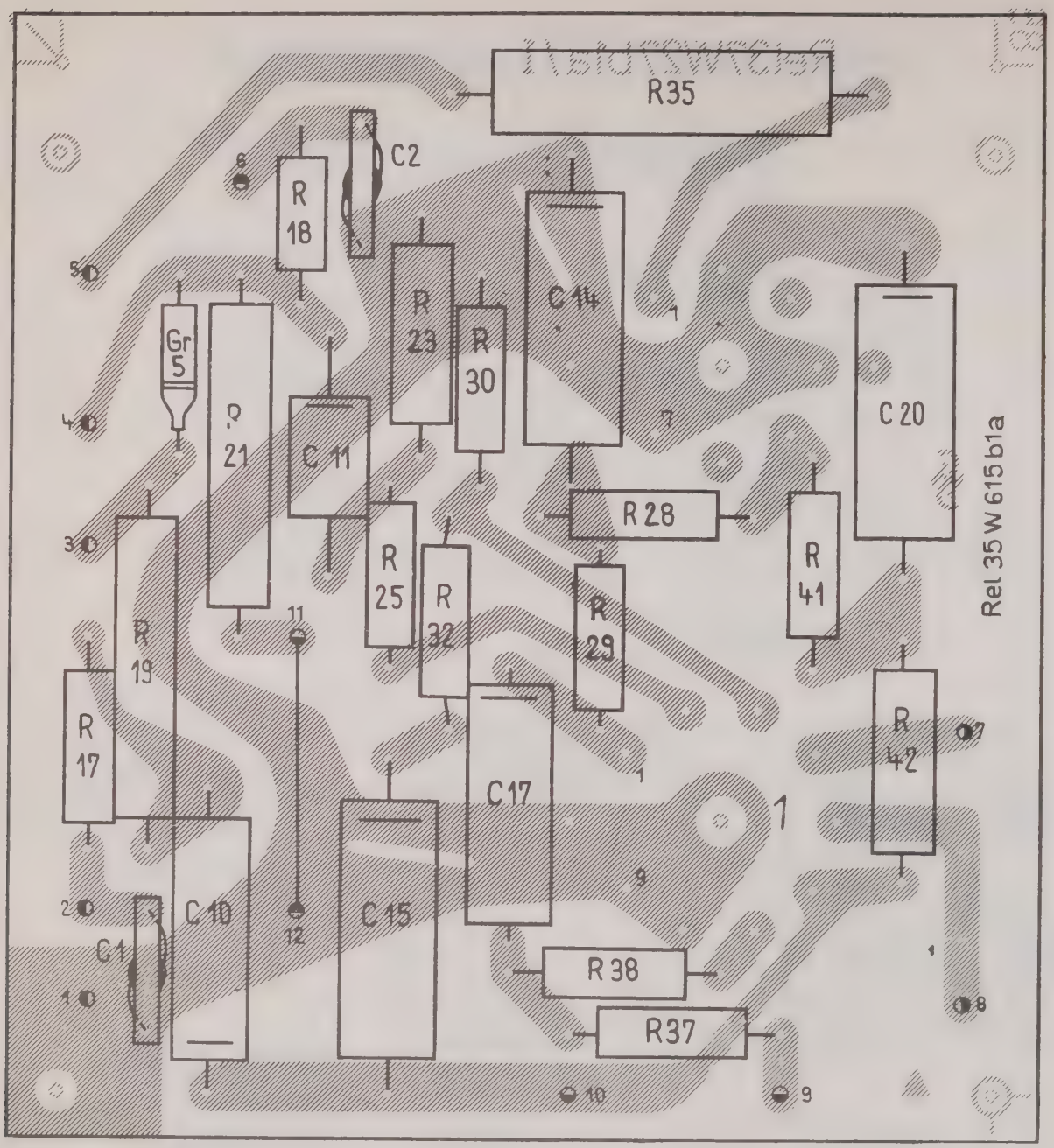
Bauteileplatte Hubregler Rel ms 35 W 613b1a Ausg. III
COMPONENT BOARD DEVIATION CONTROL Rel ms 35 W 613b1a ISSUE III

Bauteileplatte Rel 35 W 614b1a (Ausgabe II)
COMPONENT BOARD (ISSUE II)

C 5	1	Tantal-Elektrolyt-Kond. TANTALUM ELECTROLYTIC CAP'R 10µF ±20%; 20V-	B45170-J3106-M
Gr 2-4	3	Silizium-Diode SILICON DIODE	Rel Bv 672 R 168a 20
R 9	1	Drahtwiderstand WIRE-WOUND RESISTOR 10kΩ ±5%; 2W	10 K GWD 2 Fa.Rosenthal
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 10	1	3kΩ ±5%; 0,25W	B51263-A2302-J
R 11,13	2	5kΩ ±5%; 0,25W	B51263-A2502-J
R 14	1	Thernewid THERNEWID THERMISTOR	K 11 ±10% 1 K 3,5



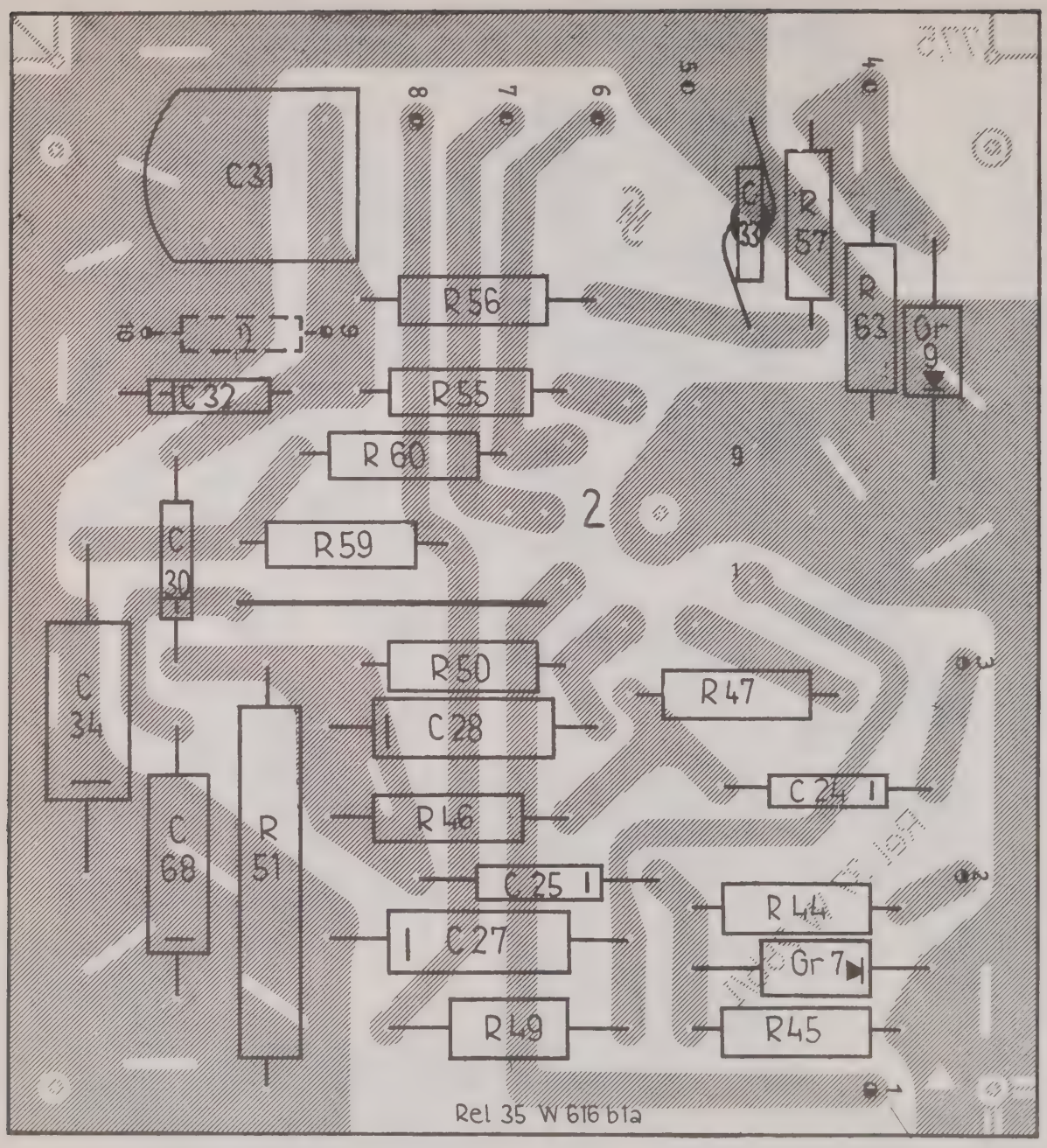
Bauteileplatte Rel ms 35 W 614b1a Ausg. II
COMPONENT BOARD Rel ms 35 W 614b1a ISSUE II



Strombahnen auf der Rückseite
CURRENT PATHS ON THE REAR

Leiterplatte 1 Rel ms 35 W 615b1a Ausg. II
CONDUCTOR BOARD 1 Rel ms 35 W 615b1a ISSUE II

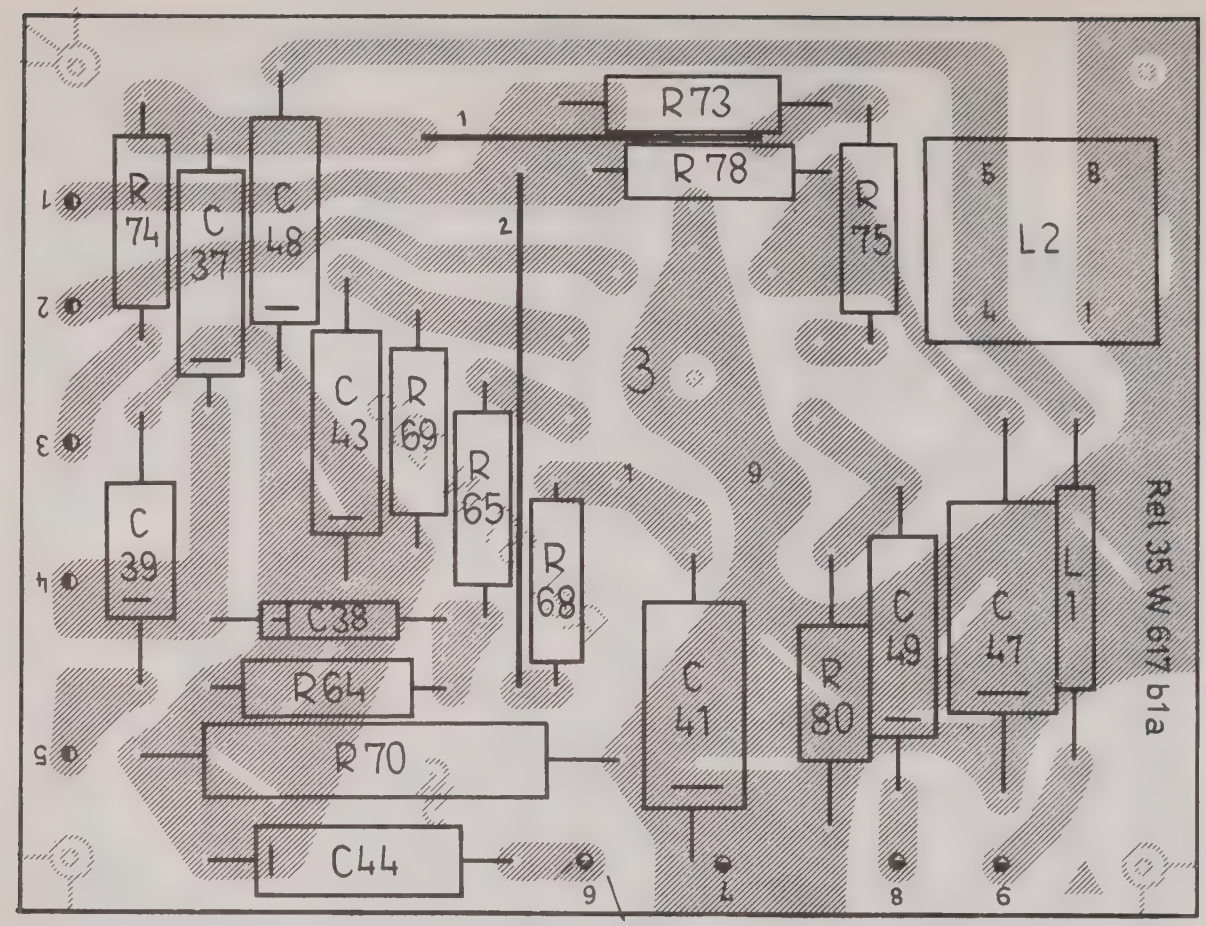
		Keramik-Kondensator CERAMIC CAPACITOR	
C 1	1	3300pF +30/-20%; 500V-	B 37632 L 3300 R
C 2	1	2200pF +30/-20%; 500V-	B 37632 L 2200 R
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 10,17	2	1000pF ±10%; 500V-	B31142-A5102-K
C 11	1	470pF ±2%; 500V-	B31140-A5471-G
C 14,15,20	3	MKH-Kondensator MKH CAPACITOR 0,1µF ±20%; 300V-	B32220-A3104-M
Gr 5	1	Vario-Cap VARIABLE CAPACITOR	1 N 950 (Fa.Hughes)
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 17	1	200kΩ ±5%; 0,25W	B 51263 A 200 K 5/2
R 18	1	180kΩ ±5%; 0,25W	B 51263 A 180 K 5/2
R 19	1	15kΩ ±5%; 0,25W	B 51265 A 15 K 0,5/0,5
R 23	1	1MΩ ±5%; 0,33W	B 51264 A 1 M 5/2
R 21	1	60Ω ±1%; 0,25W	B 51265 A 60 Ω 1/0,5
R 22	1		Wert wie eingebaut VALUE AS MOUNTED
R 25,28 38,41	4	100Ω ±5%; 0,25W	B 51263 A 100 Ω 5/2
R 29	1	40kΩ ±5%; 0,25W	B 51263 A 40 K 5/2
R 30	1	3kΩ ±5%; 0,25W	B 51263 A 3 K 5/2
R 31	1		Wert wie eingebaut VALUE AS MOUNTED
R 32	1	8kΩ ±5%; 0,25W	B 51263 A 8 K 5/2
R 35	1	7kΩ ±5%; 1W	B 51266 A 7 K 5/2
R 37	1	25kΩ ±5%; 0,25W	B 51263 A 25 K 5/2
R 42	1	5kΩ ±5%; 0,33W	B 51264 A 5 K 5/2
R 24	1	Metall-Schichtwiderstand METAL LAYER-TYPE RESISTOR 15kΩ ±0,5%; 0,25W	B 54401 A 9153 D



Strombahnen auf der Rückseite
CURRENT PATHS ON THE REAR

Leiterplatte 2 Rel ms 35 W 616b1a Ausg. II
CONDUCTOR BOARD 2 Rel ms 35 W 616b1a ISSUE II

		Keramik-Kondensator CERAMIC CAPACITOR	
C 24	1	50pF ±2%; 500V-	B 38223 N075 J 50 G
C 30	1	10pF ±0,25pF; 500V-	B 38223 N075 C 10 C
C 32	1	18pF ±5%; 500V-	B 38223 N075 C 18 J
C 33	1	4700pF +30/-20%; 500V-	B 37632 L 4700 R
C 25	1	Kf-Kondensator PLASTIC-FOIL CAPACITOR 500pF ±5%; 125V-	B 31140 A 1501 J
		MKH-Kondensator MKH CAPACITOR	
C 27,34	2	0,1µF 300V-	B32220-A3104-M
C 28	1	0,022µF 300V-	B32220-A3223-M
C 68	1	0,047µF ±20%; 300V-	B32220-A3473-M
C 31	1	Lufttrimmer AIR-DIELECTRIC TRIMMER 2/31pF	Rel ko 130cb
Gr 7,9	2	Germanium-Diode GERMANIUM DIODE	GD 3 E
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 44,57	2	8kΩ ±5%; 0,25W	B 51263 A 8 K 5/2
R 45,63	2	25kΩ ±5%; 0,25W	B 51263 A 25 K 5/2
R 46	1	500kΩ ±5%; 0,33W	B 51264 A 500 K 5/2
R 47,55	2	100Ω ±5%; 0,25W	B 51263 A 100 Ω 5/2
R 49	1	1,2kΩ ±5%; 0,33W	B 51264 A 1,2 K 5/2
R 50	1	120Ω ±5%; 0,25W	B 51263 A 120 Ω 5/2
R 51	1	4kΩ ±5%; 1W	B 51266 A 4 K 5/2
R 56	1	400kΩ ±5%; 0,33W	B 51264 A 400 K 5/2
R 59	1	4kΩ ±5%; 0,25W	B 51263 A 4 K 5/2
R 60	1	5kΩ ±5%; 0,25W	B 51263 A 5 K 5/2

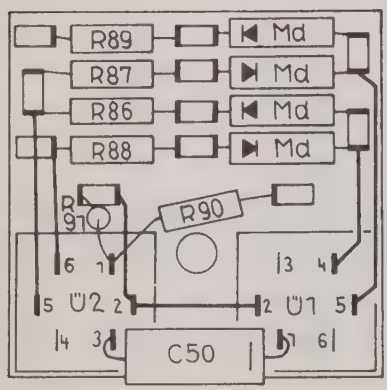


Strombahnen auf der Rückseite
CURRENT PATHS ON THE REAR

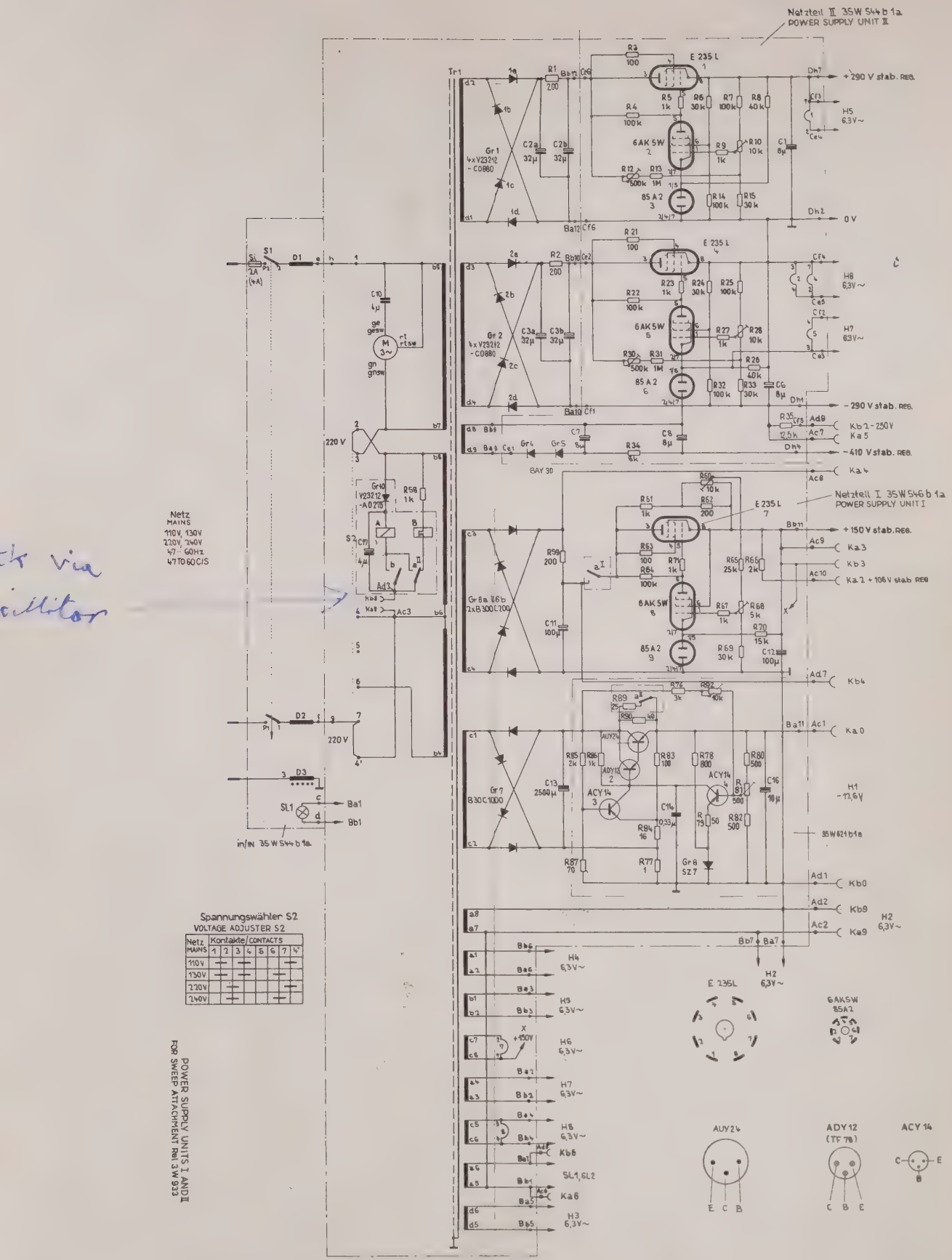
Leiterplatte 3 Rel ms 35 W 617b1a Ausgabe II
CONDUCTOR BOARD 3 Rel ms 35 W 617b1a ISSUE II

		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 37	1	200pF ±2%; 500V-	B31140-A5201-G
C 39	1	500pF ±5%; 125V-	B31140-A1501-J
C 38	1	Keramik-Kondensator CERAMIC CAPACITOR 50pF ±2%; 500V-	B 38223 N075 J 50 G
		MKH-Kondensator MKH CAPACITOR	
C 41,47	2	0,1µF 300V-	B32220-A3104-M
C 43,44 48,49	4	0,022µF 300V-	B32220-A3223-M
L 1	1	UKW-Drossel VHF REACTOR 3µH / 3A	B82501-A-A13
L 2	1	Spule COIL	Rel Bv 622 N 3491
R 64	1	Schichtwiderstand LAYER-TYPE RESISTOR 50kΩ ±5%; 0,25W	B 51263 A 50 K 5/2
R 65,75	2	100Ω ±5%; 0,25W	B 51263 A 100 Ω 5/2
R 68	1	600Ω ±5%; 0,25W	B 51263 A 600 Ω 5/2
R 69	1	120Ω ±5%; 0,25W	B 51263 A 120 Ω 5/2
R 70	1	4kΩ ±5%; 1W	B 51266 A 4 K 5/2
R 73	1	400kΩ ±5%; 0,33W	B 51264 A 400 K 5/2
R 74	1	60kΩ ±5%; 0,25W	B 51263 A 60 K 5/2
R 78	1	500Ω ±5%; 0,25W	B 51263 A 500 Ω 5/2
R 80	1	2,5kΩ ±5%; 0,33W	B 51264 A 2,5 K 5/2

		Modulationsstufe Rel 35 W 618b1a MODULATING STAGE	(Ausgabe II) (ISSUE II)
C 50	1	MKL-Kondensator MKL CAPACITOR 0,22µF 60V-	B32110-D9224-M
Md	1	Modulator MODULATOR	Rel Bv 672 R 3
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 86-89	4	80Ω ±2%; 0,25W	B 51263 A 80 Ω 2/2
R 90	1	150Ω ±5%; 0,25W	B 51263 A 150 Ω 5/2
R 91	1	800Ω ±5%; 0,25W	B 51263 A 800 Ω 5/2
		Übertrager TRANSFORMER	
Ü 1	1		Rel Bv 622 N 3401
Ü 2	1		Rel Bv 622 N 3485



Modulationsstufe Rel ms 35 W 618b1a Ausg. II
MODULATING STAGE Rel ms 35 W 618b1a ISSUE II



Netzteil I und II
POWER SUPPLY UNITS I AND II

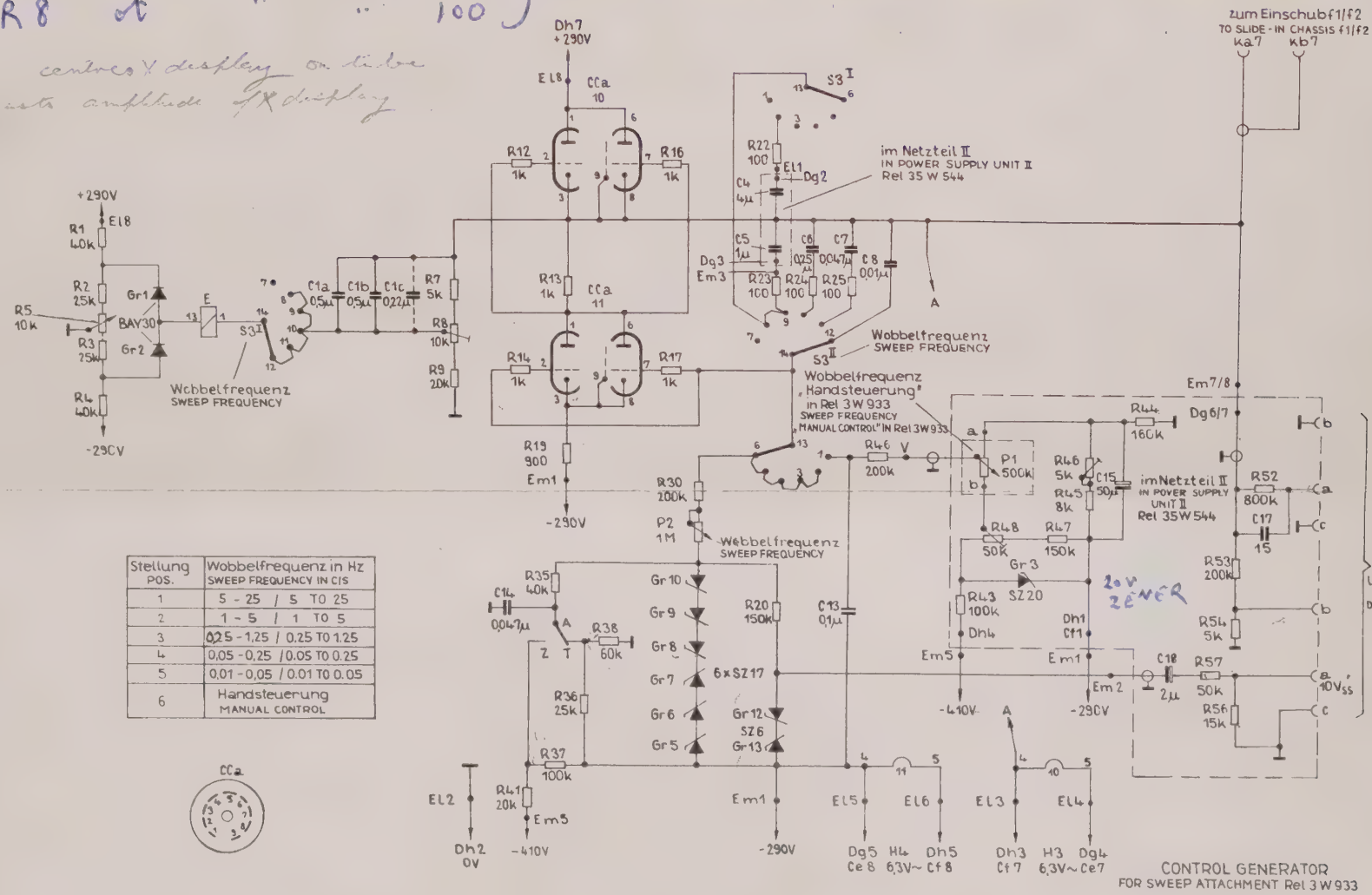
Rel str 35 W 544b1a Dt/

Ausg.II 23.8.65 Brehmer

Vervielfältigung dieser Unterlage sowie Verwertung und Mitteilung ihres Inhaltes unzulässig, soweit nicht ausdrücklich zugestanden. Zuwiderhandlungen sind str
bar und verpflichten zu Schadenersatz (LitUrhG, UWG, BGB). Alle Rechte für den Fall der Patenterteilung oder GM-Eintragung vorbehalten.

Adjust R5 at Centre Freq. } to cover sweep evenly throughout band.
" R8 at " " 100 }

R5 - centres X display on tube
R8 adjusts amplitude of X display



Stellung POS.	Wobbelfrequenz in Hz SWEEP FREQUENCY IN C/S
1	5 - 25 / 5 TO 25
2	1 - 5 / 1 TO 5
3	0,25 - 1,25 / 0.25 TO 1.25
4	0,05 - 0,25 / 0.05 TO 0.25
5	0,01 - 0,05 / 0.01 TO 0.05
6	Handsteuerung MANUAL CONTROL

Steuergenerator
CONTROL GENERATOR

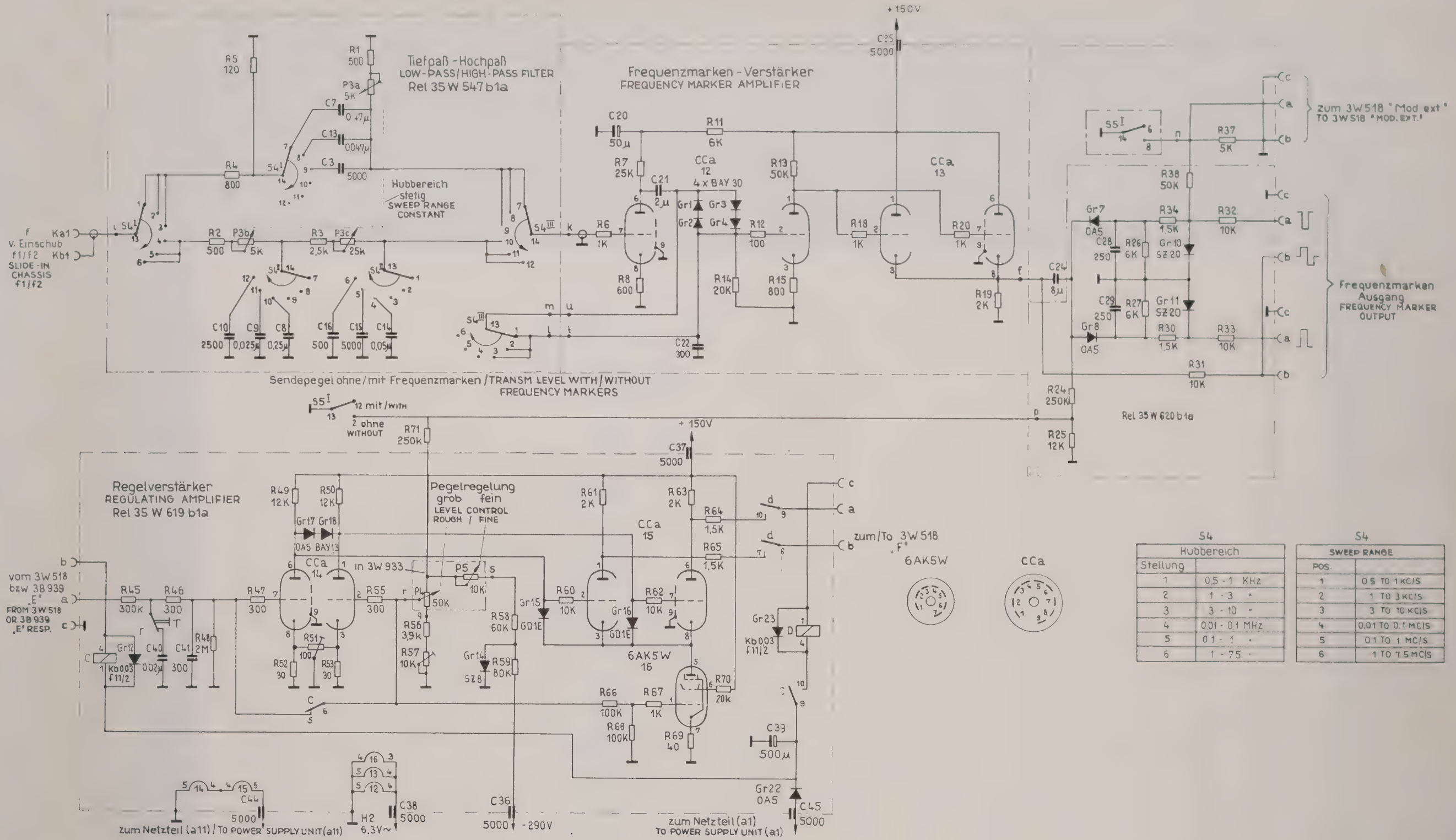
Rel str 35 W 545b 1a Dt/En

Ausg. II 23.8.65 Brehmer

Vervielfältigung dieser Unterlage sowie Verwertung und Mitteilung ihres Inhaltes unzulässig, soweit nicht ausdrücklich zugestanden. Zuwiderhandlungen sind strafbar und verpflichten zu Schadenersatz (LitUrhG, UWG, BGB). Alle Rechte für den Fall der Patenterteilung oder GM-Eintragung vorbehalten.
SIEMENS & HALSKE Aktiengesellschaft

SIEMENS

SIEMENS



S4

Hubbereich	
Stellung	
1	0,5 - 1 KHz
2	1 - 3 "
3	3 - 10 "
4	0.01 - 0.1 MHz
5	0.1 - 1 "
6	1 - 7.5 "

S4

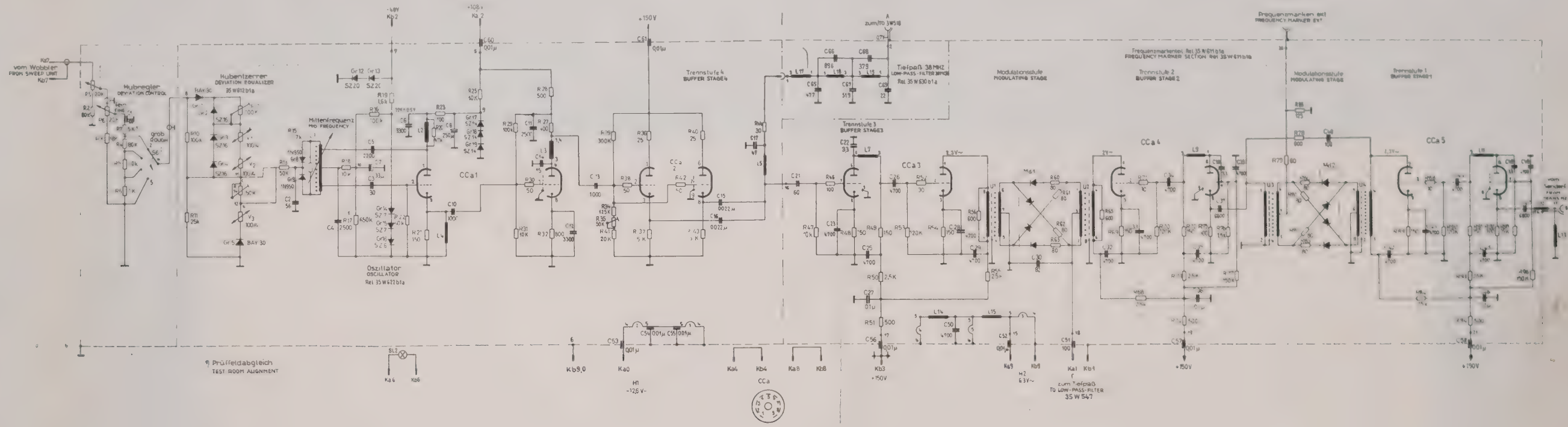
SWEEP RANGE	
POS.	
1	0.5 TO 1 KC/S
2	1 TO 3 KC/S
3	3 TO 10 KC/S
4	0.01 TO 0.1 MC/S
5	0.1 TO 1 MC/S
6	1 TO 7.5 MC/S

Frequenzmarken- und Regelverstärker
FREQUENCY MARKER AND REGULATING AMPLIFIER

Rel str 35 W 548b 1a Dt/En

Ausg. II 23.8.65 Brehmer

Vervielfältigung dieser Unterlage sowie Verwertung und Mitteilung ihres Inhaltes unzulässig, soweit nicht ausdrücklich zugestanden. Zuwiderhandlungen sind strafbar und verpflichten zu Schadenersatz (LitUrhG, UWG, BGB). Alle Rechte für den Fall der Patenterteilung oder GM-Eintragung vorbehalten.
SIEMENS & HALSKE Aktiengesellschaft



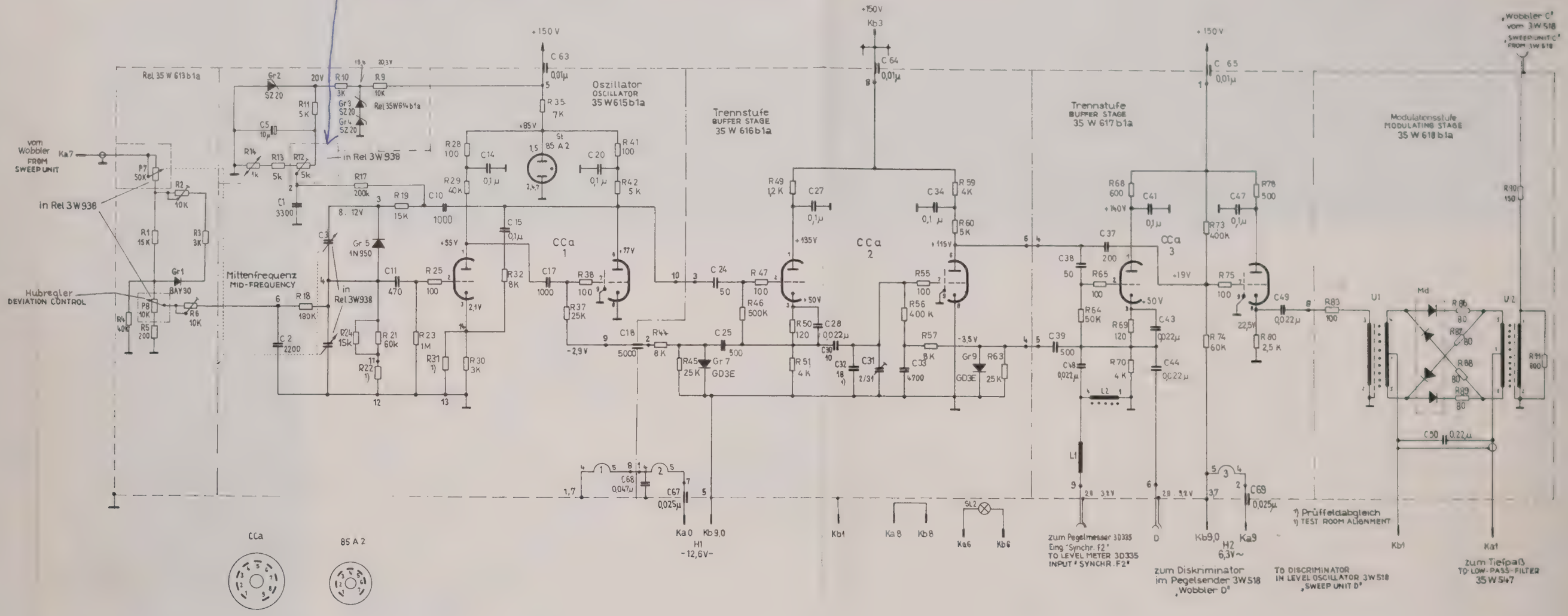
Wobbeloszillator I (±8 kHz...±8 MHz) Rel str 3 W 937b 1a Dt/En
SWEEP OSCILLATOR I (±8 KC/S TO ±8 MC/S)

Ausg. II 7.9.65 Brehmer

Vervielfältigung dieser Unterlage sowie Verwertung und Mitteilung ihres Inhaltes unzulässig, soweit nicht ausdrücklich zugestanden. Zuwiderhandlungen sind strafbar und verpflichten zu Schadenersatz (LitUrhG, UWG, BGB). Alle Rechte für den Fall der Patenterteilung oder GM-Eintragung vorbehalten.
SIEMENS & HALSKE Aktiengesellschaft

ADJUSTS CENTRE FREQ.

SIEMENS



Wobbeloszillator II (±0,5..±10 kHz) Rel str 3 W 938b1a Dt/En
SWEEP OSCILLATOR II (±0,5 TO ±10 KC/S)

Ausg. II 9.9.65 Brehmer

Vervielfältigung dieser Unterlage sowie Verwertung und Mitteilung ihres Inhaltes unzulässig, soweit nicht ausdrücklich zugestanden. Zuwiderhandlungen sind strafbar und verpflichten zu Schadenersatz (LitUrhG, UWG, BGB). Alle Rechte für den Fall der Patenterteilung oder GM-Eintragung vorbehalten.

SIEMENS

Seitenansicht
SIDE VIEW

Si
sw
P1
gr
S1
D3
rt
3
Rel 35 W 544 b1a
C18 +
in Rel 35 W 545 b1a

P1
Frontplatte
FRONT PANEL

Ansicht von oben
TOP VIEW

Rel 35 W 544 b1a
Rel 35 W 545 b1a
Rel 35 W 547 b1a
Rel 35 W 548 b1a
Rel 35 W 546 b1a

P5
P4
RE
S5
Anschlag
STOP
S5

Kabel 2
Kabel 1
Kabel 3

Ansicht von unten
BOTTOM VIEW

Rel 35 W 548 b1a
Rel 35 W 547 b1a
Rel 35 W 545 b1a
Rel 35 W 544 b1a
Rel 35 W 546 b1a

Wobbelzusatz
SWEEP ATTACHMENT

Rel ms 3 W 933b 1a Dt/En

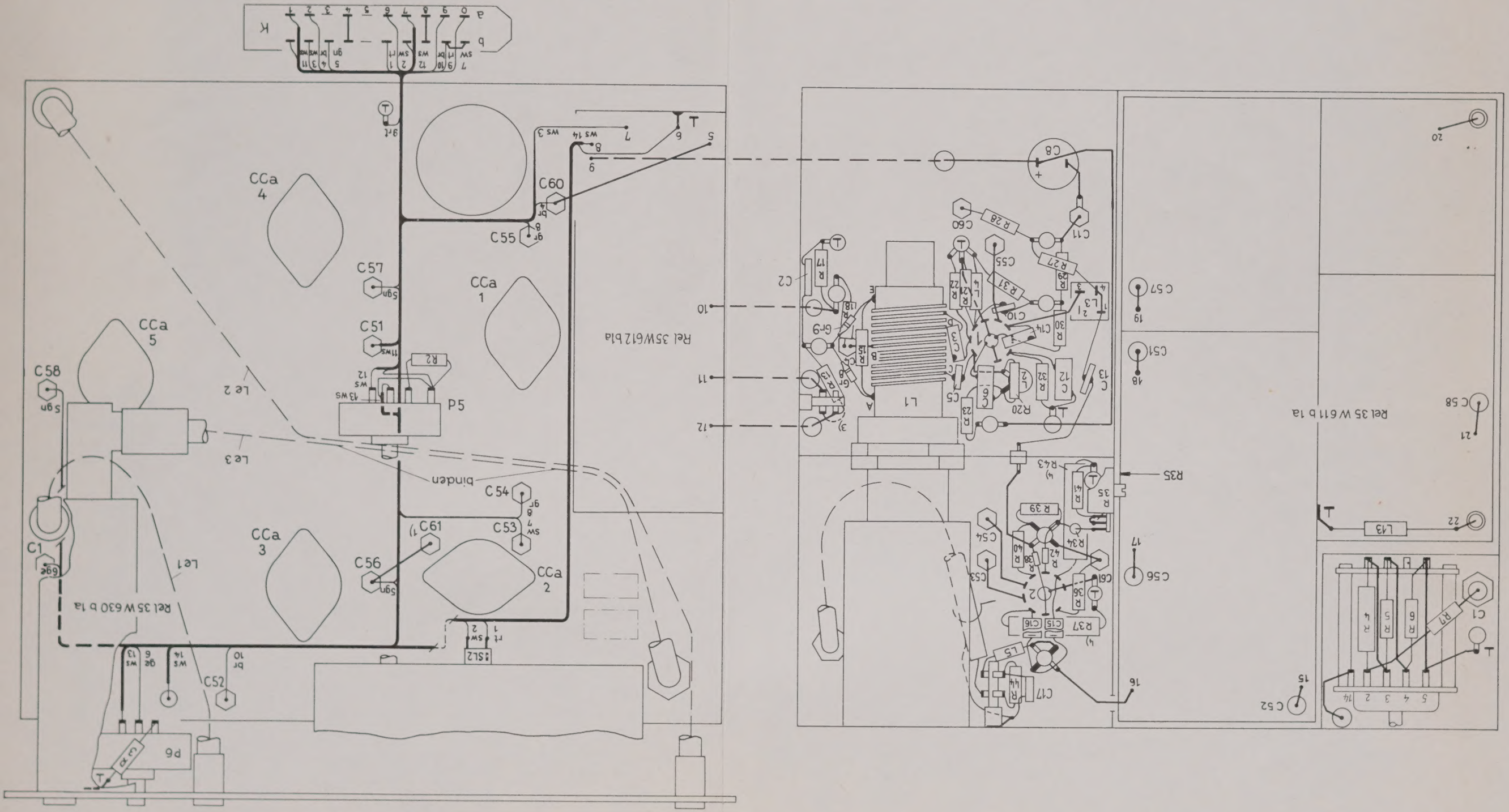
Ausg. III 23.8.65 Brehmer

Vervielfältigung dieser Unterlage sowie Verwertung und Mitteilung ihres Inhaltes unzulässig, soweit nicht ausdrücklich zugestanden. Zuwiderhandlungen sind strafbar und verpflichten zu Schadenersatz (LitUrhG, UWG, BGB). Alle Rechte für den Fall der Patenterteilung oder GM-Eintragung vorbehalten.
SIEMENS & HALSKE Aktiengesellschaft

Wobbeloszillator I (±8 kHz...±8 MHz) Rel ms 3 W 937b 1a Dt/En
SWEEP OSCILLATOR I (±8 KC/S TO ±8 MC/S)

Ausg. III 7.9.65 Brehmer

Vervielfältigung dieser Unterlage sowie Verwertung und Mitteilung ihres Inhaltes unzulässig, soweit nicht ausdrücklich zugestanden. Zuwiderhandlungen sind strafbar und verpflichten zu Schadenersatz (LitUrhG, UWG, BGB). Alle Rechte für den Fall der Patenterteilung oder GM-Eintragung vorbehalten.
SIEMENS & HALSKE Aktiengesellschaft



SIEMENS